



United States Department of Agriculture
Natural Resources Conservation Service



LITTLE SNAKE RIVER RESTORATION PROJECT DRAFT ENVIRONMENTAL ASSESSMENT

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LIST OF ACRONYMS

APE	Area of Potential Effect
BLM	Bureau of Land Management
BMP	Best Management Practices
CWA	Clean Water Act
CCWP	Carbon County Weed and Pest
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CFS	Cubic feet per second
EA	Environmental Assessment
ESA	Endangered Species Act
HUC	Hydrologic Unit Code
LSRCD	Little Snake River Conservation District
NEPA	National Environmental Policy Act
NRCS	Natural Resources and Conservation Service
NHRP	National Register of Historic Places
SHPO	State Historic Preservation Office
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WYCRO	Wyoming Cultural Records Office

1. INTRODUCTION

The Natural Resources Conservation Service (NRCS) proposes a project to restore approximately six channel-miles of the Little Snake River located primarily upstream of the Town of Baggs, Wyoming to improve aquatic habitat and restore the channel to a properly functioning condition (Figure 1). An assessment of the channel stability indicates high lateral instability with considerable aggradation and channel enlargement potential. Consequently, sediment supply within this reach is high (Little Snake River Conservation District 2011).

Existing irrigation diversion structures within the reach are contributing to channel instability by reducing sediment transport capacity and enlarging the channel. Additionally, the diversion structures are currently creating fish barriers and fragmenting native fish habitat. Furthermore, maintenance of the historical diversion structures has reached a point that will require either rehabilitation or replacement.

The Town of Baggs' water treatment plant infiltration gallery is impacted by sediment problems and has the potential to be flanked entirely with an oxbow cutoff. Both of these issues are a result of cumulative effects of channel instability, local sediment supply, and sediment transport capacity.

The primary objectives of this project are to re-establish the natural channel geometry to a Rosgen classification C-4 channel (low gradient, meandering system with point bars, pools/riffles and a well-developed floodplain), remove or modify irrigation diversions to provide for fish passage requirements, and enhance aquatic habitat. Other objectives include minimizing the loss of productive agricultural lands, creating habitat, improving the riparian stream buffer, and creation of wetlands.

There are several components of this design plan that will enhance the river corridor, provide sustainable infrastructure, and improve the biological and ecological features of the system. The entire project has been designed under a geomorphic channel restoration approach. Structures incorporated into the project for diversions and grade or bank stabilization measures have been designed to allow fish passage, create habitat, and transport sediment. Any existing in-stream structures will be removed entirely or modified to eliminate barriers. At two locations along the reach there is an opportunity to create wetland areas. In addition, modifications to the channel dimensions and floodplain will help reduce flood stages near the Town of Baggs.

The Little Snake River Conservation District (LSRCD), U.S. Fish & Wildlife Service (USFWS), and Wyoming Game and Fish Department (WGFD) participated as cooperating agencies in the preparation of this Environmental Assessment (EA).

1.1 DOCUMENT FORMAT

The NRCS has prepared this EA in compliance with the National Environmental Policy Act (NEPA), consistent with Council on Environmental Quality (CEQ) and NRCS regulations and policy, and other relevant federal and state laws and regulations. The format of this document follows the guidelines set forth in the NRCS National Environmental Compliance Handbook (USDA 2011).

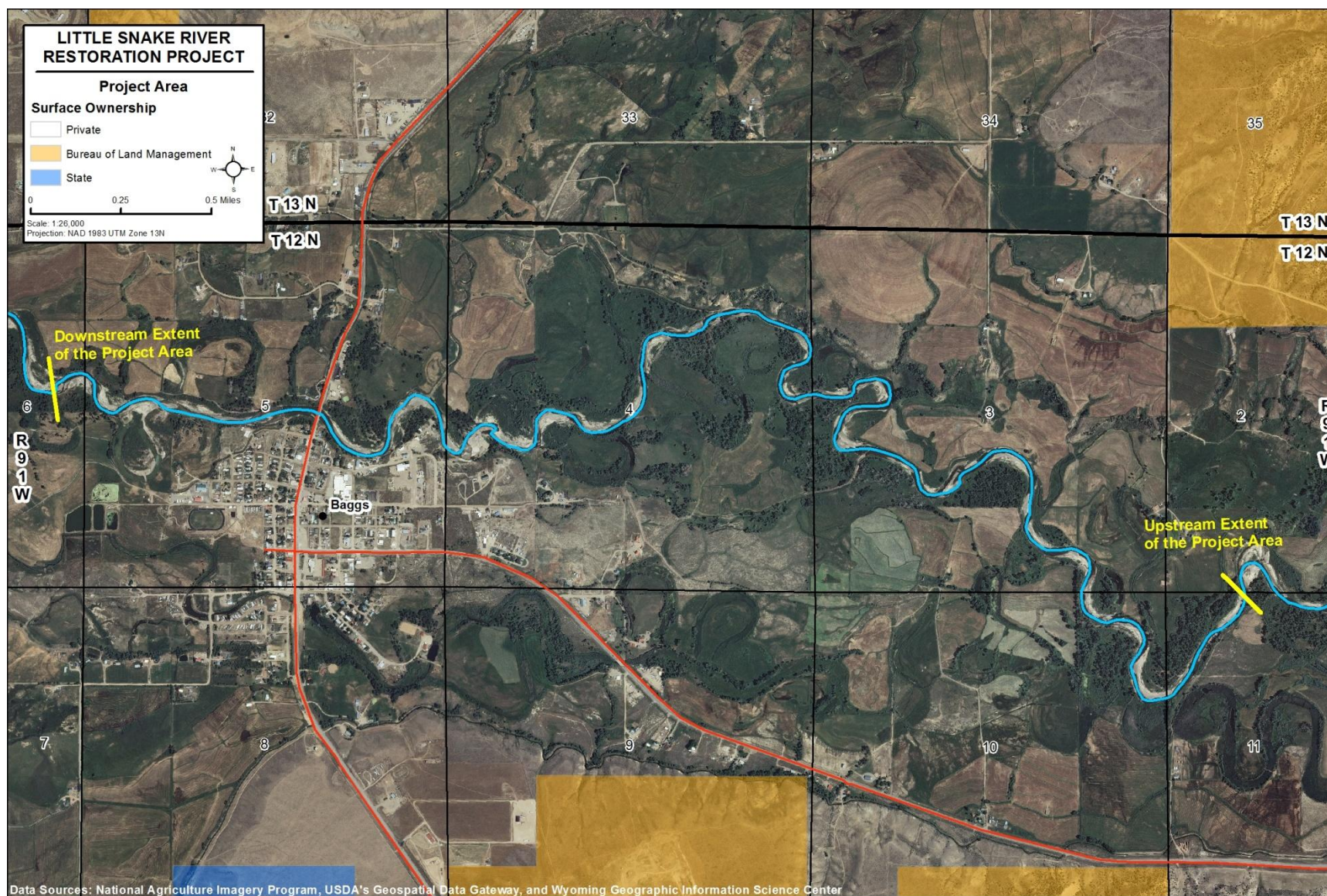


Figure 1 Location map

The Descriptions of Alternatives section describes the No Action Alternative and the Proposed Action Alternative. The Affected Environment description outlines existing conditions of each resource, including agriculture, cultural resources, water resources, threatened and endangered species, aquatic resources, and socioeconomic resources. The Environmental Consequences section reviews the effects of each of the alternatives to each resource.

Additional documentation, including more detailed analyses of project area resources, may be found in project planning records located at the LSRCD Office in Baggs, Wyoming.

1.2 PURPOSE OF ACTION

The purpose of the restoration is to stabilize the channel, reduce the local and upstream sediment supply, enhance aquatic and terrestrial habitat, and eliminate habitat fragmentation of native fishes. The installation of in-stream features using rock and large woody debris would improve bank stability and create aquatic habitat. Step pools would stabilize the stream reach and prevent channel erosion. Wetlands created would provide habitat for mammals, waterfowl, amphibians, and reptiles. Restoring hydrology within the 1.5 to 2-year flood plain will result in the deposition of fine sediment, which will promote cottonwood recruitment and improve cottonwood gallery health and vigor, thus providing habitat for species using that habitat type.

1.3 NEED FOR ACTION

There is a need to establish sediment transport continuity because anthropogenic factors have altered the natural channel processes and functions of the Little Snake River, reducing the ability of the river to transport sediment. Anthropogenic factors include: alteration of the hydrograph associated with the City of Cheyenne, Wyoming trans-basin water diversion; construction and operation of High Savery Dam and Reservoir; changes to the channel width near the State Highway 789 Bridge; a riprap section installed to protect the Baggs water treatment plant; and dike construction that restricted access to the flood plain after the 1984 floods in Baggs. In addition, irrigation diversions located upstream and within the project reach have altered the natural channel slope.

Reduced sediment transport has resulted in aggradation of the river channel and this contributes to declining pool and riffle morphology and width-to-depth ratios, which are important factors for favorable aquatic ecosystems. The aggrading river channel has accelerated lateral migration of the channel, which is resulting in loss of high-value cottonwood gallery riparian forest, wetlands, irrigated hay lands, and irrigation infrastructure in the riparian corridor. Accelerated bank erosion associated with lateral channel migration contributes to increased fine sedimentation of the water column reducing water quality and further impairing aquatic life. The Town of Baggs' water treatment plant infiltration gallery is also impacted by sediment problems and has the potential to be flanked entirely with an oxbow cutoff. Additionally, irrigation diversion structures are fragmenting habitat of native and desirable fish species.

1.4 DECISION FRAMEWORK

The CEQ regulations implementing NEPA (40 CFR Parts 1500-1508) require federal agencies to prepare EAs to assist them in determining whether they need to prepare an Environmental Impact Statement (EIS) for actions that have not been categorically excluded from NEPA. The CEQ has defined “major federal action” to include activities over which federal agencies have control. Consistent with CEQ and NRCS regulations, this EA is a concise public document that briefly provides sufficient evidence and analysis for determining whether to prepare an EIS or a “finding of no significant impact.”

1.5 SCOPING PROCESS

Scoping is defined as “...an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action” (40 CFR 1501.7). During the development of the proposed action, an internal scoping meeting was held in Rawlins, Wyoming on January 13, 2012. The meeting was attended by members of the NRCS, LSRCD, and USFWS and scoping issues associated with the following resources were identified:

- Agriculture (scheduling of irrigation water and property access)
- Cultural Resources (potential impacts to historic properties and irrigation ditches)
- Water Resources (impacts due to an increase in turbidity and total suspended solids during construction)
- Invasive Plant Species (minimization of spread during construction)
- Infrastructure (effects associated with modifying and replacing existing irrigation diversions)
- Socioeconomic Resources (impact on the local economy)
- Vegetation (impacts to riparian habitat)
- Wildlife (potential habitat disturbance)
- Federally Listed Threatened and Endangered Species (potential habitat disturbance)
- Aquatic Resources (potential habitat disturbance)

2. ALTERNATIVES

Alternative 1 is the No Action Alternative and Alternative 2 is the Proposed Action Alternative. Additional alternatives were considered during the planning process, but were not considered in detail for reasons documented in Section 2.4.

2.1 ALTERNATIVE 1 – NO ACTION ALTERNATIVE

Under the No Action Alternative, the proposed action would not be implemented and no other new actions would be undertaken. Under this alternative, current conditions would follow their current pattern; channel instability coupled with accelerated lateral migration and increased sediment loading rates would continue to degrade in-stream bed features, riparian, and wetland habitat. Habitat fragmentation for sensitive native fish species would persist, potentially resulting in a declining population and listing under the Endangered Species Act (ESA).

2.2 ALTERNATIVE 2 – PROPOSED ACTION

Restoration would attenuate and remediate negative impacts from past anthropogenic factors within the project reach. To accomplish this multiple activities are proposed and are described in more detail below (Little Snake River Conservation District 2011). Restoration activities identified by planned stream reach are summarized in Table 1 and shown in Figure 2. It should be noted that portions of the upstream reach have previously been restored (stream reach A through C).

Table 1 Restoration Activities Identified by Stream Reach

Stream Reach	Estimated Channel Length (feet)	Restoration Activities
D through F	7,300	Bank stabilization with channel shaping
G	6,700	Replacement of two irrigation diversions, channel restoration, creation of two side channels, and creation of wetlands
H	3,425	Channel and alignment restoration with oxbow wetland creation
I	3,900	Replacement of one irrigation diversion and channel restoration
J	2,650	Channel and bend restoration
D through J	24,000	Channel feature enhancement in the pools and riffles

Pools and riffles are the most common habitat features currently missing that would be restored under this alternative. Restoration would include narrowing and deepening the current channel and improving pool, riffle, run, and glide segments to be consistent with the fluvial morphology and natural geometry for a river of this size. The longitudinal profile of the river will not vary appreciably from the original, or only minimally within localized reaches, to create stable pools and riffles features to match the altered hydrology and sediment transport of the watershed.

The proposed structures used for diversions and grade or bank stabilization measures have been designed to allow aquatic organism passage, create habitat, and transport sediment. Cross-vane rock structures have been selected to replace existing irrigation diversions and to stabilize the riverbed and riverbank (Figure 3).

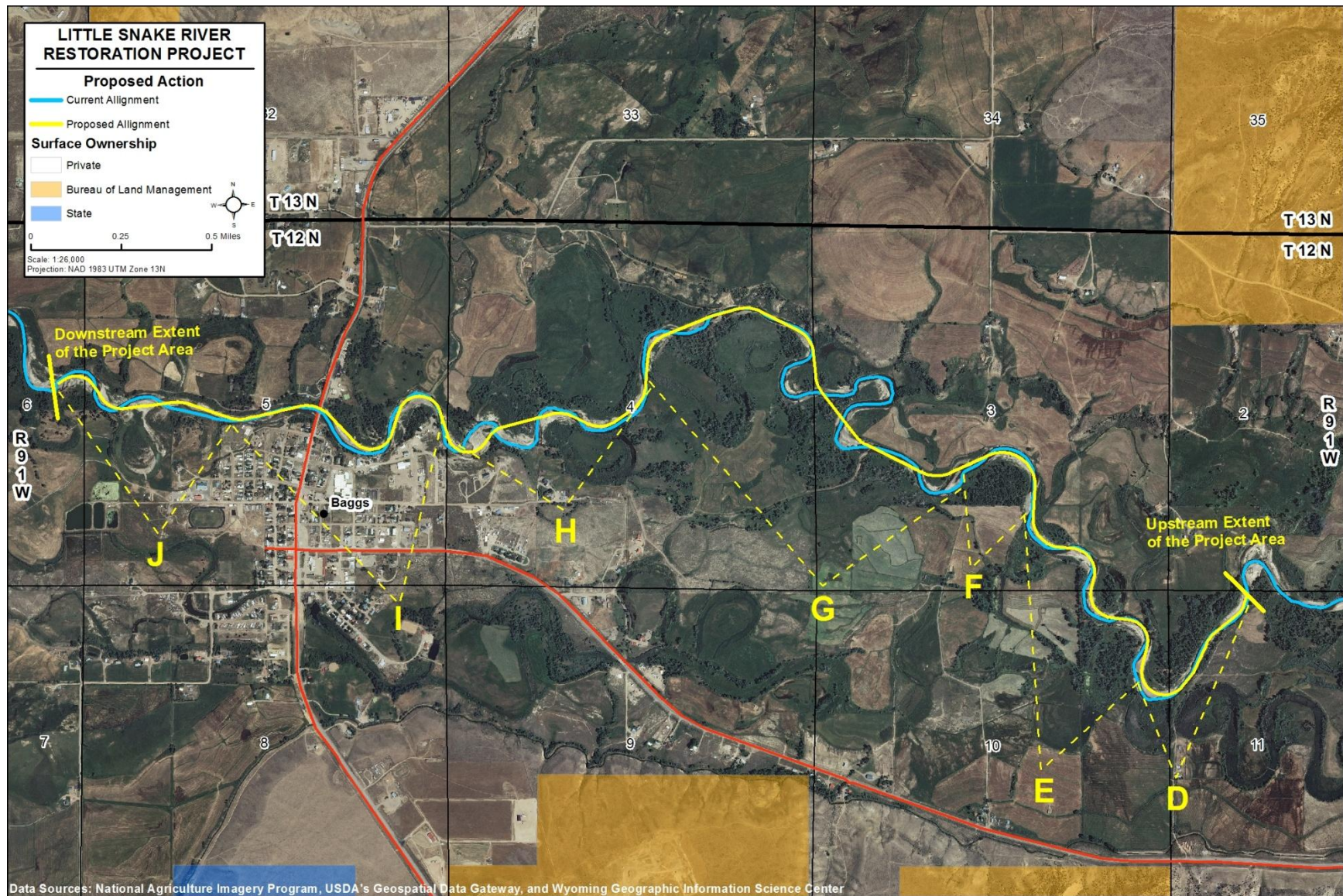


Figure 2 Project area

In total, seven cross-vane rock structures would be installed. Six rock J-hook vanes would be used to reduce near-bank stresses and to create contraction scour holes for larger compound pools, and forty-one rock barbs would be installed to reduce near-bank stresses and to define the thalweg in stream bend locations. Random boulder clusters would be located at each constructed glide/riffle bar feature. The installation of boulder clusters would be unique at each location, and are proposed to assist with grade control and an increase in aquatic habitat. In addition, in order to prevent further erosion from occurring, existing rock riprap would be supplemented or extended at two locations.

Stream bank stabilization structures consisting of a toe wood base layer covered with fill, willow cuttings, and sod mats are also proposed on the outer side of several bends within the project area. Rock and log sills would be used for stabilization and would be constructed on floodplain benches adjacent to the channel.

Approximately 3,500 linear feet of side channel would be created from channel realignments.

Side channels would be dredged and filled as

required to create a low gradient step pool channel consisting of about 90 percent pools and 10 percent step chutes. The creation of side channels would be performed concurrently with the wetlands creation described below. Side channels have been designed to carry flow nearly all year long with provisions to accommodate flood flows. Log sills in the main channel floodplain would be utilized to reduce inflow during flood stages, and rock sills would be incorporated into the low flow step chutes to maintain the constructed side channel. Additionally, two log inlet structures proposed at the entrance to the side channels would be used to limit flow during rising and receding stages of the main channel (Figure 4).

Wetland habitat would be increased in total number of acres, and existing wetlands would be enhanced through improved hydrology and diversification of existing wetland types. Under this alternative, two larger wetlands would be created at the same time as and adjacent to proposed side channels, and six oxbow wetlands would also be created (Figure 5). Restored wetland features will be constructed parallel to the main river channel, thus lowering the value of these areas as nursery habitat for non-native fish species (Hill 2004).

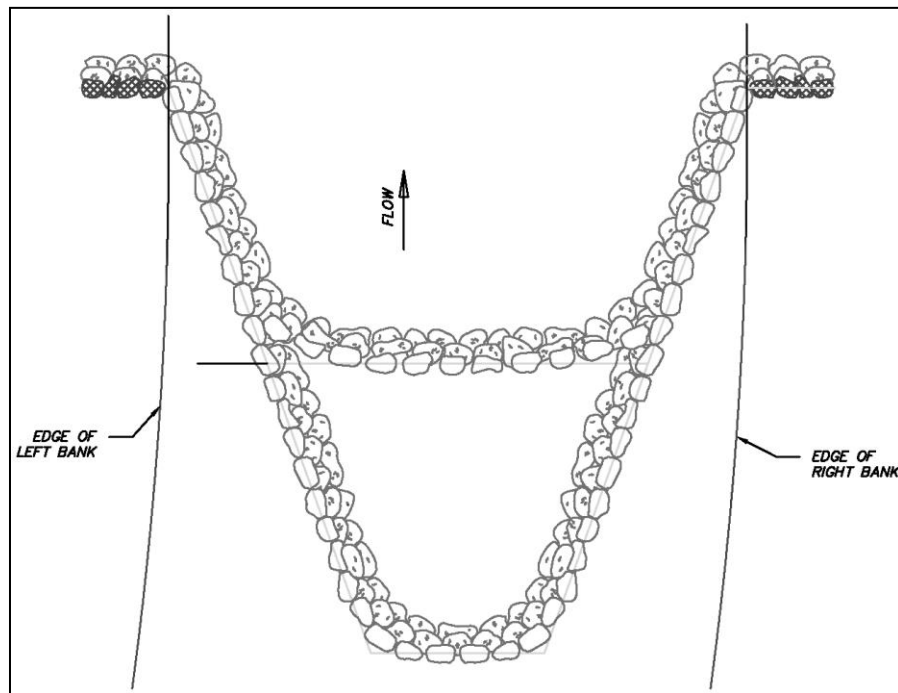


Figure 3 Typical cross-vane rock structure

Vegetation planted along the project reach would include willow clump transplants, sod mat transplants, live willow stakes, and live cottonwood sills. It is anticipated that all vegetation would be obtained on or near the site from native species.

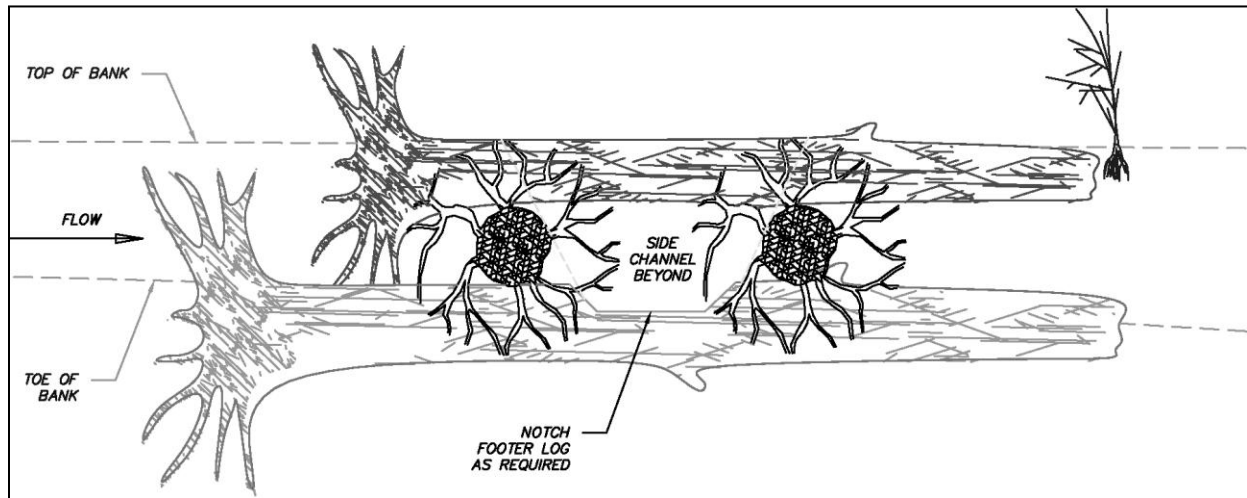


Figure 4 Typical log inlet structure

Heavy equipment used to accomplish restoration work would consist of general earthmoving equipment. Excavators of various sizes would be utilized for excavation purposes. A Cat 330 or larger would be needed for rock placement in the structures. During project implementation, excavators, dozers, front end loaders, and skid steer loaders would be used to move and place the majority of earth materials and an end dump truck with low ground pressure would be used to transport fill up and down the channel.

The construction window is limited with a target range of late July/early September to March, primarily due to the constraints of high water conditions in May through June, irrigation season of May through July, and possible raptor and migratory bird nesting generally starting in the month of March.

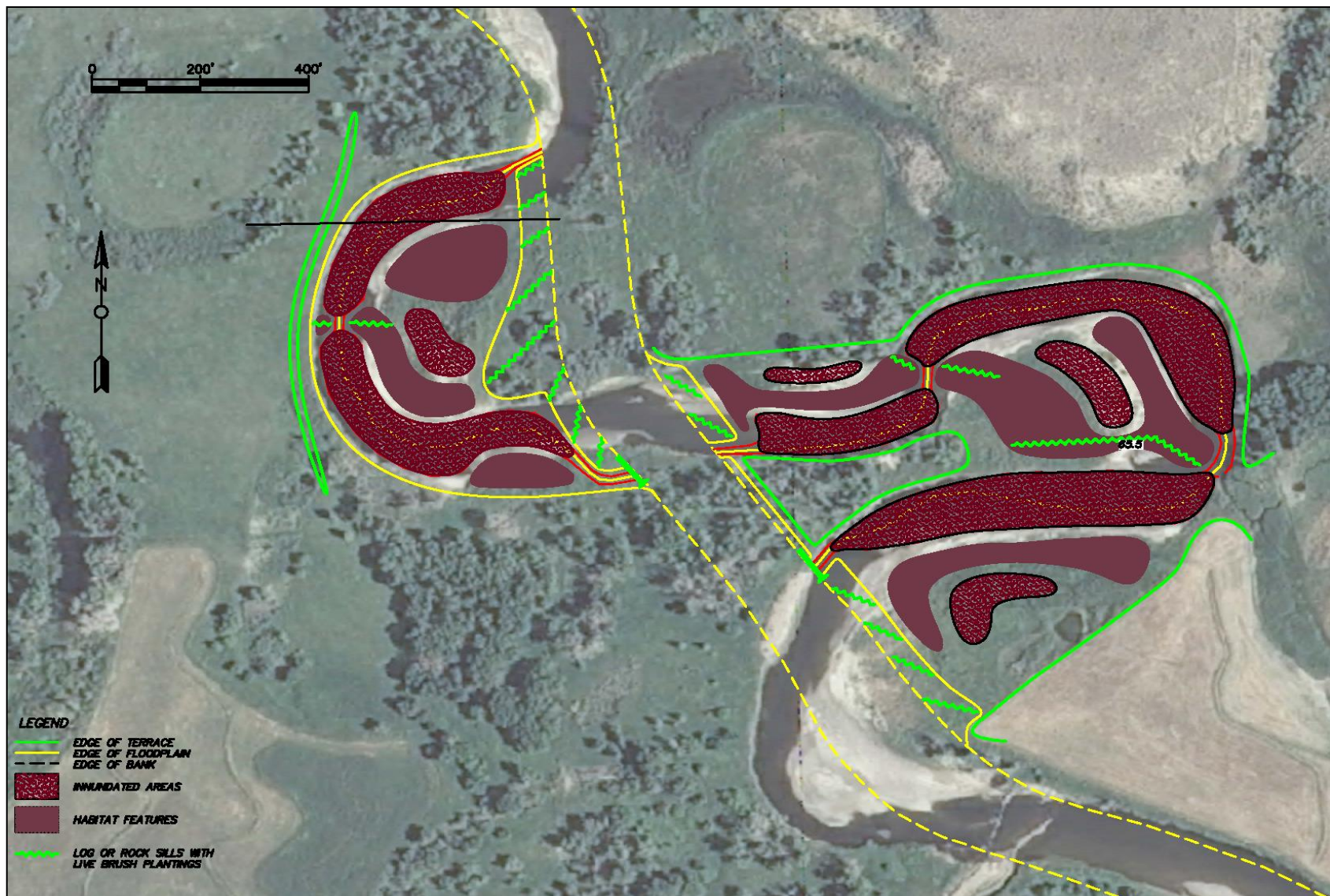


Figure 5 Side channels and two larger wetland areas proposed

2.3 RESOURCE PROTECTION MEASURES

In order to reduce or avoid potential adverse environmental effects associated with the Proposed Action Alternative, resource protection measures were evaluated for all resource areas analyzed in the EA.

2.3.1 Agriculture

Irrigation scheduling and property access will be mitigated through open channels of communication with adjacent landowners.

2.3.2 Cultural Resources

The NRCS provided notification of this undertaking to the Advisory Council on Historic Preservation, Wyoming State Historic Preservation Office (SHPO), Little Snake River Museum, Northern Arapaho Tribe, Eastern Shoshone Tribe, and the Northern Ute Tribe.

The NRCS conducted a Class I investigation of the project area. The LSRCD retained a Cultural Resources Management firm that conducted limited subsurface testing within the project area. There is minimal potential for unknown cultural resources within the project area. Nevertheless, an inadvertent discovery plan is in place for the duration of the project. If any previously unknown cultural resources are inadvertently discovered during any phase of the project, activities will immediately cease in that vicinity and the State Cultural Resources Specialist will be notified.

2.3.3 Water Resources

Best Management Practices (BMP) will be used to reduce erosion, such as staged construction and installation of silt fences.

2.3.4 Infrastructure

The analysis did not identify any adverse effects needing resource protection measures.

2.3.5 Socioeconomic Resources

The analysis did not identify any adverse effects needing resource protection measures.

2.3.6 Vegetation

The LSRCD will conduct photo-point monitoring in cooperation with landowners in order to document the changes in channel configuration and vegetation disturbance within the construction zone. The photo-points will be used to monitor the progress of vegetation re-establishment in disturbed areas.

2.3.7 Invasive Plant Species

An integrated approach suggested by Carbon County Weed and Pest (CCWP) will be undertaken for preventing, controlling, and monitoring any new spread of noxious weeds from activity created by the proposed action. The approach will include options for chemical, mechanical, and biological treatments. Management plans will be implemented on a site-by-site basis depending on the species involved and private landowner involvement. In addition, the CCWP suggests that private landowners adjacent to the

project area work with the CCWP in developing a noxious weed management plan in case noxious species spread to their lands as a result of this project.

2.3.8 Wildlife Resources

- Critical nesting periods will be identified in order to minimize short term disturbance to avian species.
- Downed woody debris will be left scattered in grassland areas to provide cover and invertebrate foraging opportunities.

2.3.9 Federally Listed Threatened and Endangered Species

The USFWS Intra-Section 7 Project Specific Review Process did not identify any adverse effects needing resource protection measures.

2.3.10 Aquatic Resources

BMPs will be used to reduce erosion, such as staged construction and installation of silt fences.

The creation of wetlands will follow guidelines established by the Upper Colorado River Endangered Fish Recovery Program to eliminate use by northern pike where feasible. The construction of oxbow and side channel wetlands will incorporate design features to limit northern pike habitat and accessibility to these habitats. Restored wetland features will be constructed parallel to the main river channel, thus lowering the value of these areas as northern pike nursery habitat (Hill 2004). Proposed wetland areas have been designed as shallow sites to encourage the growth of riparian woody plants (willow and cottonwood) and to discourage possible overwintering of northern pike, eliminating the need for drawdown structures. Any deepwater habitat created will be isolated from flood flows and mainstem connection points in order to prevent recruitment of northern pike in the Little Snake River (Colorado Division of Wildlife 2010).

2.4 ALTERNATIVES CONSIDERED BUT DISMISSED FROM FURTHER CONSIDERATION

The following alternative was considered but dismissed from further consideration for the reasons provided.

2.4.1 Use Riprap to Stabilize Channel

The use of riprap (rock material) to prevent erosion, stabilize stream banks, and provide in-stream stability was considered. However, riprap installation would not eliminate habitat fragmentation since irrigation diversions would not be removed or modified. Riffle, run, and glide segments would also continue to be inconsistent with the fluvial morphology and natural geometry for a river of this size and aquatic habitat would not be improved. It was determined that the use of riprap only in the project area would increase bank erosion downstream and would further reduce bank vegetation and aquatic habitat complexity. This is because riprap tends to increase the speed of water flow along an armored reach and this additional strength of flow presents issues further downstream as water is deflected off the riprap and directed at other points of riverbank (U.S.Department of Homeland Security's Federal Emergency Management Agency 2009).

In areas of low vegetation, riprap can reflect light into the water and cause an increase in water temperatures (U.S.Department of Homeland Security's Federal Emergency Management Agency 2009) and an increase in water temperature is already a concern due to channel enlargement. In addition, riprap loses structural integrity during and after high-flow events and monitoring and maintenance would likely become costly and time consuming.

For these reasons, this alternative did not meet the need for the project and has been eliminated from further consideration.

2.5 COMPARISON OF ALTERNATIVES

Table 2 and Table 3 provide a comparison of the No Action Alternative and the Proposed Action Alternative.

Table 2 Summary of Project Goals

Project Goals	Alternative 1 – No Action	Alternative 2 – Proposed Action
Restoration (channel length), including pool, riffle, run, and glide segments	0	Approximately 24,000 feet
Irrigation diversions (fish barriers) replaced	0	Three
Side channels created	0	Two side channels created (totaling approximately 3,500 feet)
Side channel wetlands created	0	Two 11 acres (estimated) 6 acres permanently inundated (estimated)
Oxbow wetlands created	0	Six 4 acres (estimated)

Table 3 Summary of Effects Indicators

Effects Indicators	Alternative 1 – No Action	Alternative 2 – Proposed Action
Modeled ¹ bank erosion	8,978 tons/yr	Five years after project completion (modeled prediction) 229 tons/yr
Agriculture	Bank erosion and irrigated land loss	Bank stabilization and protection of irrigated lands
Water treatment plant infiltration gallery	Impaired function due to sediment loading	Improved function
Functional wetlands	Continued loss	Restored hydrology and increase in acreage
Riparian and old growth cottonwood gallery forest	Continue loss	Maintained habitat and increase in age class and diversity

¹ Using the BANCs model

Effects Indicators	Alternative 1 – No Action	Alternative 2 – Proposed Action
Aquatic organism diversity	Degraded condition due to high sediment load and physical barriers	Habitat improved through reduction in sediment and replacement of irrigation diversions
Habitat fragmentation for native fish	Continued fragmentation	Reconnection of main stem of Little Snake River with major tributary on Muddy Creek

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section summarizes the environmental and social resources to be affected (40 CFR 1502.14) by the alternatives under consideration and the environmental consequences (40 CFR 1502.16) of each alternative. Certain resources have a different analysis area in order to fully analyze direct, indirect, or cumulative effects for that specific resource.

3.1 AGRICULTURE

Analysis Area: The analysis area for agriculture includes the project area and adjacent agricultural lands.

Approximately 16,000 acres of land within the Little Snake River watershed are presently in irrigated agriculture (WWC Engineering 2010). The amount of irrigated agriculture within the project area is approximately 2,500 acres. These non-developed lands are held in fee simple ownership by private landowners. There are two basic crops raised in the irrigated acreage, including 89 percent grass and hay pasture and 11 percent alfalfa (WWC Engineering 2010). The crops are historically used to supplement grazing needs of local livestock during the non-growing season in the Little Snake River valley. Typically one cutting of grass hay and alfalfa can be obtained within the relatively short growing season in the valley above Baggs.

Within the project area there are three irrigation diversion structures, irrigation ditches, head gates, and other irrigation related infrastructure. Livestock management infrastructure includes fences, water gaps, and corrals. Damage to this agricultural infrastructure has resulted from bank erosion associated with excessive lateral river migration.

In the years since the flood of 1984, and including the flood of 2011, hay and croplands have suffered damage and irrigated pasture loss due to accelerated lateral migration and subsequent flooding. This has negatively impacted local ranchers and farmers within the project area. Figure 6 compares the channel position for year 1994, year 2009, and year 2011 along a section of the project area. Excessive silt transported into irrigation ditches and canals necessitates silt removal in these structures for conveyance of irrigation water, which results in additional costs to landowners. The impacts of erosion are also witnessed and felt by the many landowners in the project area when the spring and summer run-off is higher than normal. The erosion of croplands also has a secondary related effect in causing a heavier bed load to occur farther downstream. This causes depositions in areas of the river that are non-productive for aquatic habitat and may damage irrigated fields with river silt depositions.

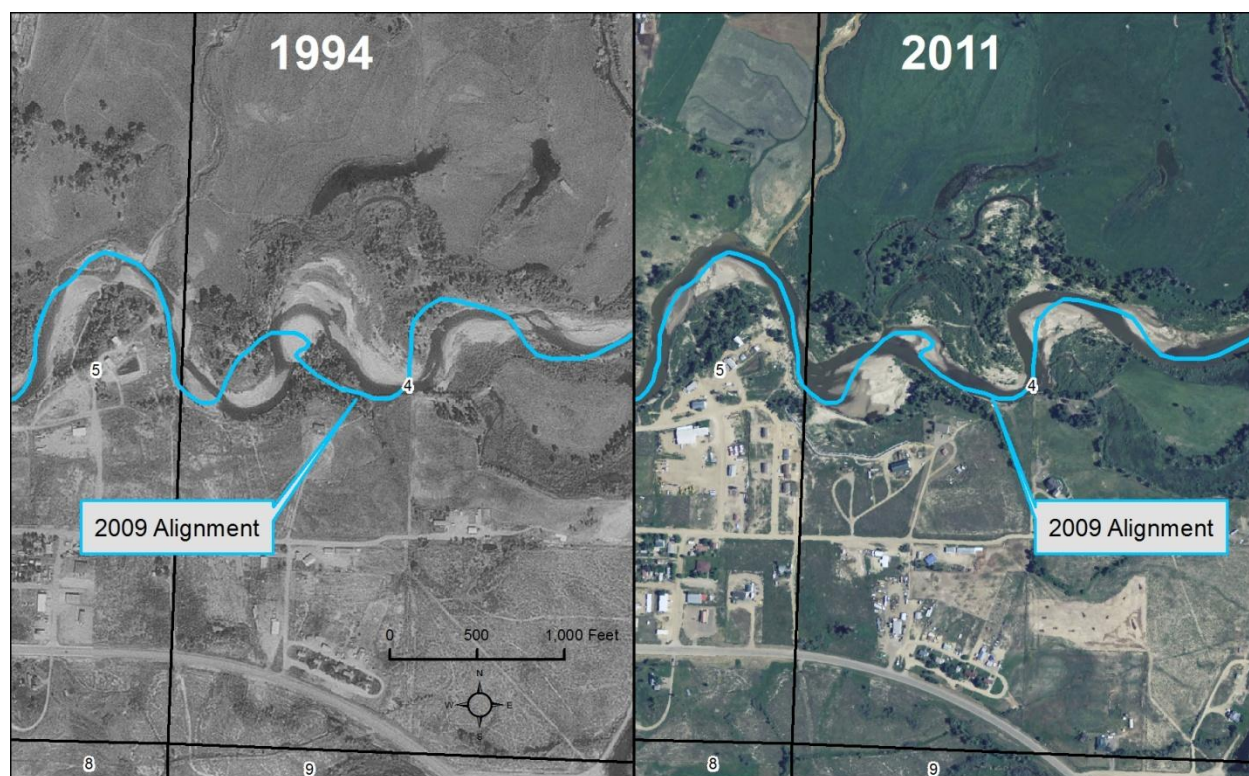


Figure 6 Year 1994, 2009, and 2011 channel alignment along a section of the project area

3.1.1 Alternative 1 – No Action

Under the No Action Alternative, impacts to agriculture would continue due to current erosion and flooding patterns. Excess silt would continue to be transported into irrigation ditches and canals, requiring removal for conveyance of irrigation water. Irrigation ditches would not be removed or modified and irrigation efficiency would remain the same or decrease.

3.1.2 Alternative 2 – Proposed Action

The proposed action would protect irrigated croplands, irrigated pasture, and sub-irrigated and dry land pasture in the project corridor from further erosion and subsequent loss.

The construction phase of the project, including preparatory actions for construction, may cause short term effects including: compaction of irrigated pastures for direct hauling of construction materials to the various job sites; scheduling irrigation water and irrigating; and an inconvenience in accessing property for routine management. However, the landowners that are participating in the project have been consulted with and have a good understanding of the equipment and materials necessary for completion of the project. Thus, almost all impacts to private landowners would be mitigated through open channels of communication.

Any direct impacts to agriculture would be short term and overcome within or between growing seasons. Indirect effects to rangelands south of the river would not be adverse, as silt deposition would be lessened in irrigated land areas downstream.

3.2 CULTURAL RESOURCES

Analysis Area: The analysis area for cultural resources is the project area.

The project area has potentially seen human occupation for approximately the last 12,000 years. The geographic area is located at the intersection of at least two cultural traditions, each of which provides its own temporal variation and associated material culture. In general, the last 12,000 years are divided into two major categories: Prehistoric and Historic. The Prehistoric period includes the Paleo-Indian, Archaic, and Prehistoric sub-divisions, while the Historic period is generally divided into Proto-historic and Early Historic sub-divisions.

Federally recognized Indian tribes whose ancestors inhabited the area are the Northern Arapaho, Eastern Shoshone, and the Ute. Metal and glass projectile points, as well as trade beads, firearm projectiles, and casings provide the primary diagnostic artifacts.

Irrigation in the area dates back to the 1880s and developed out of necessity, as semiarid regions do not provide adequate year-round water. Thus, settlement of the area depended upon it. The first order of business for settlers was digging ditches to take mountain snowmelt from streams to fields on the dry sunny lowlands. The earliest “pioneer ditches” watered bottomlands next to streams through small, hand-dug channels; the larger were dug with plow and scraper. Professional engineers and armies of paid laborers built great canals up to 100 miles long. In most cases it was the co-operative companies, which “were as bountiful as the crops that could be grown with water” that built them (Cassity 2011). Comprehensive water development projects were later built and frequently incorporated earlier ditches and canals into their distribution systems (Holleran and Chalana 2006).

The tradition of farming irrigated lands in the project area dates to the early to mid historic period and continues today, utilizing many of the original ditches, though modified through time and maintenance.

3.2.1 Class I Inventory

The archival records search for the area located documentation for 24 sites, which were previously recorded over 13 surveys. This includes both surveys for historic and prehistoric sites as well as an architectural survey. The majority of these surveys were for roads (Wyoming Cultural Records Office [WYCRO] numbers 49759, 55039, 13913, 18630, 18629, 27619), communication lines (WYCRO numbers 60462, 25806, 60821), or pipelines (WYCRO number 32632). These linear surveys were not located in close proximity to the Little Snake River corridor since they were conducted in the uplands located outside of the project area. Therefore they have limited value for interpreting the potential for impacts to cultural resources within the Area of Potential Effect (APE) by this project. One block survey was conducted on Bureau of Land Management (BLM) land for a pasture (WYCRO number 16204) and another for a communications site (WYCRO number 60462).

In April 2012, a field inventory conducted in the APE by NRCS and USFWS cultural resource specialists concluded that there is little potential for intact buried cultural resources. Other recent and relevant work completed in the APE was conducted in 2011 by Pronghorn Archaeology (Hatcher 2011). The survey work included surface observation using transects and block survey of existing diversion areas where work is proposed. Among the diversions noted were the Ready, Adams, and Baggs. Pronghorn Archaeology also determined that there is little potential for intact buried cultural resources, or evidence

of aboriginal habitation, because the area is considered an active floodplain. This work did not include intensive records research for irrigation related resources, nor did it record previously unreported cultural resources.

There are three documented prehistoric sites within the project APE. Through consultation, they were determined not eligible for listing on the National Register of Historic Places (NRHP).

The built environment surrounding the project area consists of man-made objects, such as buildings, other structures, and roads. The built environment consist of three distinct types (buildings, roads/trails, and irrigation ditches), which are discussed in the following subsections.

Buildings, Roads, and Trails

Many of the documented sites located outside of the APE are historic buildings associated with the Town of Baggs, which were recorded during an architectural inventory (Wyoming Recreation Commission). The majority, 19 properties, are listed as eligibility unknown whilst the remaining three are either eligible or listed on the NRHP.

Table 4 Historic Sites

Name	Eligibility
Town of Baggs (48CR3581)	Unknown
Baggs School (48CR3582)	Unknown
Baggs Town Hall (48CR3583)	Unknown
First State Bank of Baggs (48CR3584)	Listed
Birch Store and Homestead (48CR3585)	Unknown
Paul Evans House (48CR3586)	Unknown
John C. Fleming House (48CR3587)	Unknown
Hi-Way Café (48CR3588)	Unknown
Inn Hotel (48CR3589)	Unknown
Log Cabin Saloon (48CR3590)	Unknown
Gene Mathes House (48CR3591)	Unknown
Chet Morgan House (48CR3592)	Unknown
Shawls House (48CR3593)	Unknown
Charles Stephanie House (48CR3594)	Unknown
Blair House (48CR3596)	Unknown
Rawlins/Baggs Road (48CR36480)	Unknown
Seg W-X Update Freight Road (48CR3648)	Eligible
Cherokee Trail (48CR3651)	Eligible
Shanks Home (48CR3725)	Unknown

Name	Eligibility
Baggs Ranch Stage Site (48CR4788)	Unknown
BE-1 Ranch Site (48CR4792)	Unknown

Irrigation Ditches

The project area contains some of the state's earliest irrigation claims, thus several of the ditches have been recorded and evaluated for inclusion in the NRHP.

Baggs Ditch: The Baggs Ditch (48CR6168) is eligible for listing on the NRHP. The ditch was appropriated in 1877 and was the third appropriation on the Little Snake River (Quick and Rosenberg 1995). It was recorded in 1995 and the Wyoming SHPO concurred with the eligibility determination. The water right is territorial (Proof numbers 1019, 1019) and therefore there is no state permit number. There are seven appropriators irrigating 870 acres. There were no adjudicated enlargements. The Irons Ditch (territorial right) was combined with Baggs Ditch in 1991 (Parkin pers. comm.).

Ready Ditch: The Ready Ditch has not been formally recorded in the NRHP. The Certificate of Appropriation shows that the ditch was called Buzzard Bend Ditch in 1893. In 1904, W.H. Protz appropriated 1.05 cubic feet per second (CFS) and W.H. Van Flett appropriated 3.07 CFS (Wyoming State Engineer's Office 1999). The record shows a total appropriation of 6.10 CFS by 1905 (Wyoming State Engineer's Office). The state proof number for this ditch is 5215 and the permit number is 5967.

Adams Ditch: The Adams (or Franklin Ditch) has not been formally recorded in the NRHP. The original appropriation for the ditch was in 1875 for .54 CFS in Section 10 T12N R91W. At that time, it was known as Reed Ditch. The Certificate of Appropriation from 1978 shows 37.97 CFS in total appropriations were on record, documenting that the flow rate of the ditch is a reportable resource (Wyoming State Engineer's Office). In 1901, the point of diversion was moved to Section 3 (Parkin pers. comm.). Moving the point of diversion was not recorded in the Wyoming State Engineer's Office until November 3 of 1978.

3.2.1.1 *Alternative 1 – No Action*

Under the No Action Alternative, irrigation ditches may be impacted by continued channel instability and accelerated bank erosion.

3.2.1.2 *Alternative 2 – Proposed Action*

The proposed action will not adversely impact, visual or otherwise, the abovementioned historic properties because the project APE is restricted to the river channel and high-water mark. Because the proposed project would take place below the head gates—which were modernized prior to this undertaking and therefore no longer contributing elements, and within the river channel, no adverse impacts to irrigation ditches are expected.

An inadvertent discovery plan is in place for the duration of the project. If incidental or demonstrably non-NRHP eligible cultural materials or features are discovered during construction, the activities will immediately halt and the on-site construction supervisor and the NRCS State Cultural Resources Specialist will be notified. Incidental or demonstrably non-NRHP eligible cultural materials or features

include, but are not limited to, isolated pre-contact or historic period artifacts, and cultural materials younger than 50 years old. The discovery area and a surrounding buffer zone shall then be delineated with flags tied to long stakes that are driven into the ground. These stakes shall not be removed. The State Cultural Resources Specialist will thoroughly document and sample the cultural material. The buffer zone established around the discovery zone shall be large enough to allow ground disturbance activities to resume outside the buffer.

If potentially NRHP eligible cultural resources are discovered, work will immediately halt at that location and the on-site construction supervisor and the NRCS State Cultural Resources Specialist will be notified. Potentially NRHP eligible cultural materials include: evidence of prehistoric or historic features including postholes/molds, hearths, pits, walls, foundations, and other evidence of structural remains; shell midden, non-human bone, lithic debitage, formed-stone –bone –shell –wood or –fiber implements, historic-period glass and ceramics. The discovery area and a surrounding buffer zone will then be delineated with flags tied to long stakes that are driven in to the ground. These stakes shall not be removed. The buffer zone established around the discovery zone shall be large enough to allow ground disturbing activities to resume outside the buffer. The Cultural Specialist will then coordinate with the on-site construction supervisor to determine whether further impacts to the NRHP eligible cultural resources can be avoided, in which case the Cultural Specialist will thoroughly document and sample the disturbed cultural material.

Consultation with the Advisory Council on Historic Preservation, Wyoming State Historic SHPO, Little Snake River Museum, Northern Arapaho Tribe, Eastern Shoshone Tribe, and the Northern Ute Tribe has been completed as required by the National Historic Preservation Act. In addition, the undertaking is in compliance with the NRCS and Wyoming SHPO State Level Agreement.

3.3 WATER RESOURCES

Analysis Area: The analysis area for water resources is the Little Snake River-Willow Creek watershed (Figure 7).

3.3.1 Hydrology

The tributary basin to the Little Snake River includes the hydrologic units of Little Snake and Muddy Creek with respective Hydrologic Unit Codes (HUC) of 1405003 and 1405004. Muddy Creek is a tributary to the Little Snake River near the Town of Baggs. The Little Snake River flows from east to west into the Yampa River, which is a tributary to the Green River. The river network is part of the Upper Colorado region (HUC 14) and the White-Yampa sub-region (HUC 1405).

Climate in the basin is characterized by an average annual temperature of 40 to 45 degrees and a precipitation range of 8 inches to over 55 inches at alpine levels. The higher precipitation range in the basin consists primarily of snow, thus creating a snowmelt-dominated hydrograph. The basin topography ranges from roughly 6,200 feet up to the highest point in the watershed at just over 11,000 feet. The reach of the project area is at an elevation range of 6,200 feet to 6,450 feet. The contributing drainage area for the project area varies from about 950 square miles at the upstream end to about 2,300 square miles downstream.

Land use in the basin consists of approximately 25 percent forest, 70 percent range, and 5 percent agricultural. Water bodies and urban land use are estimated to comprise less than one percent for the basin. Land ownership in the watershed is a mixture of federal, state and private and land ownership in the project area is entirely private.

Only one large water storage reservoir is located within the basin and is known as High Savery Reservoir. The reservoir has a catchment basin that constitutes about 10 percent of the Little Snake hydrologic unit above the project reach. Regulated releases from the reservoir consist of a minimum discharge of 12 CFS continually for aquatic resources and up to 200 CFS during high irrigation demands (Little Snake River Conservation District).

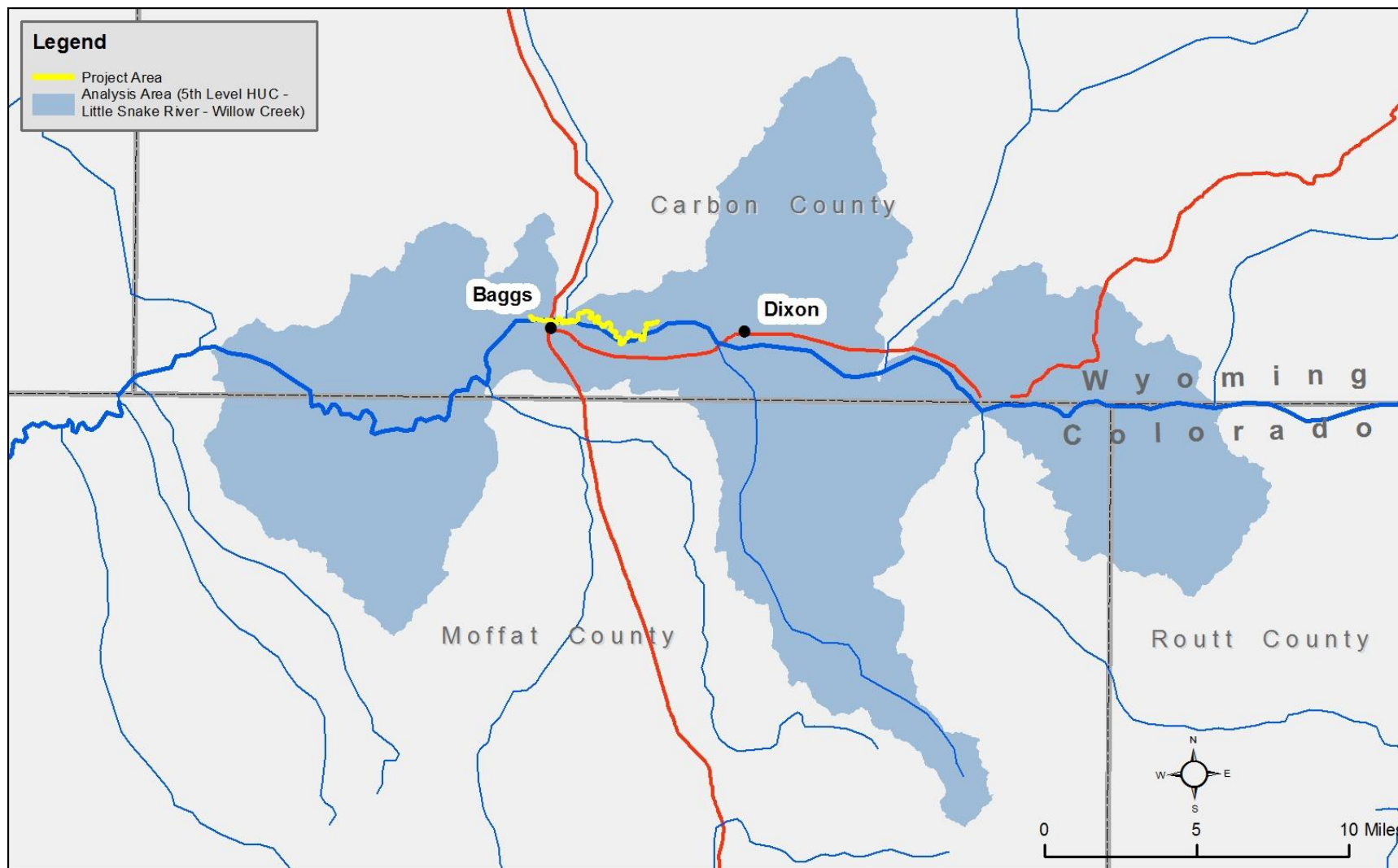


Figure 7 Little Snake River-Willow Creek watershed

Table 5 presents flood frequencies from U.S. Geological Survey (USGS) gauging station number 09257000 (Little Snake River near Dixon) and station number 09259000 (Muddy Creek near Baggs).²

Table 5 Streamflow Data from USGS Gauging Stations

Return Interval	Exceedance Probability %	Little Snake River near Dixon Drainage Area = 988 sq. miles	Muddy Creek near Baggs Drainage Area = 1,257 sq. miles
1.25	80	2,944 CFS	172 CFS
1.5	66.7	3,654 CFS	228 CFS
2	50	4,527 CFS	308 CFS
5	20	6,522 CFS	555 CFS
10	10	7,703 CFS	Insufficient years of record
25	4	9,038 CFS	Insufficient years of record
50	2	9,929 CFS	Insufficient years of record
100	1	10,741 CFS	Insufficient years of record

The unit discharge per square mile of drainage area for the 2-year event is 4.58 CFS per square mile on the Little Snake River and 0.25 CFS per square mile on Muddy Creek. This unit discharge comparison indicates that although the contributing drainage area for Muddy Creek is substantial to the basin, the contributing discharge is minor. Therefore, the hydrological characteristics of the project area are best represented by the Little Snake River Basin.

The hydrology of the watershed currently supplies the irrigation water for the diversions within the project area and the irrigation demand will not increase during the foreseeable future.

3.3.1.1 *Alternative 1 – No Action*

The hydrologic conditions would remain the same under the No Action Alternative.

3.3.1.2 *Alternative 2 – Proposed Action*

The proposed action would not negatively impact the hydrology in the watershed or downstream water resources.

3.3.2 River Corridor Function

The impairments observed in the project area have been caused by many years of homesteading, grazing, and farming. For instance, under past practices and government programs many reaches of the Little Snake River have been straightened and channelized and riparian zones have been converted to agricultural hay production. Additionally, diversions have been established along the reach with the sole purpose of obtaining irrigation water with little regard for channel stability and function of the river.

A geomorphic and analytical stability assessment of the river was performed during the planning phase of the proposed action (Little Snake River Conservation District 2011). The assessment was compared to

² <http://waterdata.usgs.gov/nwis>

historic evaluations³ completed by Wildland Hydrology Consultants. The geomorphic character of the existing river generally consists of a low gradient, meandering gravel bed channel. The channel is predominately single thread and slightly entrenched with a broad terraced flood plain. The reach based impairments identified in the geomorphic assessment included a high width-to-depth ratio, considerable deposition, accelerated bank erosion, and slight incision or abandonment of the active floodplain in portions of the reach. Additional channel impairments, such as short transverse riffle bars, central bar deposition, chute cutoffs, down-valley meander migration, typical shallow pools, and channel blockages from irrigation diversions were also noted in the assessment.

The analytical stability of the reach was evaluated for sediment transport capacity and competence. The findings of the assessment indicate that the channel only has the capacity to transport about two-thirds of the total annual sediment yield and the available hydraulic shear stress is insufficient to move the largest gravel sizes in the channel bed. Findings also suggest that aggradation is consistent with the significant deposition observed throughout the reach.

A prediction of bank erosion rates and an estimate of the total reach sediment supply from erosion were performed during the assessment. The sediment supply yield due to erosion was estimated to be 8,978 tons per year for the reach, or an average rate of 0.374 tons per year per foot. In comparison to stable reference conditions, the erosion rate of the reach has been accelerated and is at least two orders of magnitude greater than the potential stable condition.

The results of the assessment indicate that the channel is enlarging and aggrading with high lateral instability. Consequently, the natural recovery potential of the river to a stable state is considered to be poor due to multiple channel processes being in a state of disequilibrium, as well as the influences and needs of the existing in-channel and adjacent infrastructure. Further evaluation and localized impacts due to the irrigation diversions are discussed in Section 3.4.

The impaired condition of the river has numerous effects on the river corridor and the local environment. Sedimentation issues associated with the channel condition have deteriorated aquatic habitat, affected the operation and maintenance of the irrigation diversions, resulted in rehabilitation of the Baggs' water infiltration gallery, and contributed a disproportionate amount of sediment to the reach and further downstream. The bank erosion problems are resulting in the loss of riparian zones, agricultural lands, and aquatic and wildlife habitat. Moreover, the predicted annual sediment supply contribution from bank erosion throughout the reach currently exceeds the sediment transport capacity of the river. In addition, areas of the reach which have incised due to neck or chute cutoffs are abandoning the active floodplain and losing connectivity with the riparian corridor (Figure 8).

The cutoff process taking place in the reach is caused by reduced sediment transport, resulting in excess sediment deposition, accelerated outside bank erosion, and a destabilized system (Figure 8). As oxbows are cut off in the destabilized river section, entrenchment (vertical containment) ensues. Over time, due to ongoing entrenchment, the oxbows become perched and lose hydraulic connectivity with the river channel, which results in diminished habitat for avian and aquatic species.

³ http://wildfish.montana.edu/cases/methods/ThreeForks_CO_assess.asp?ProjectID=41

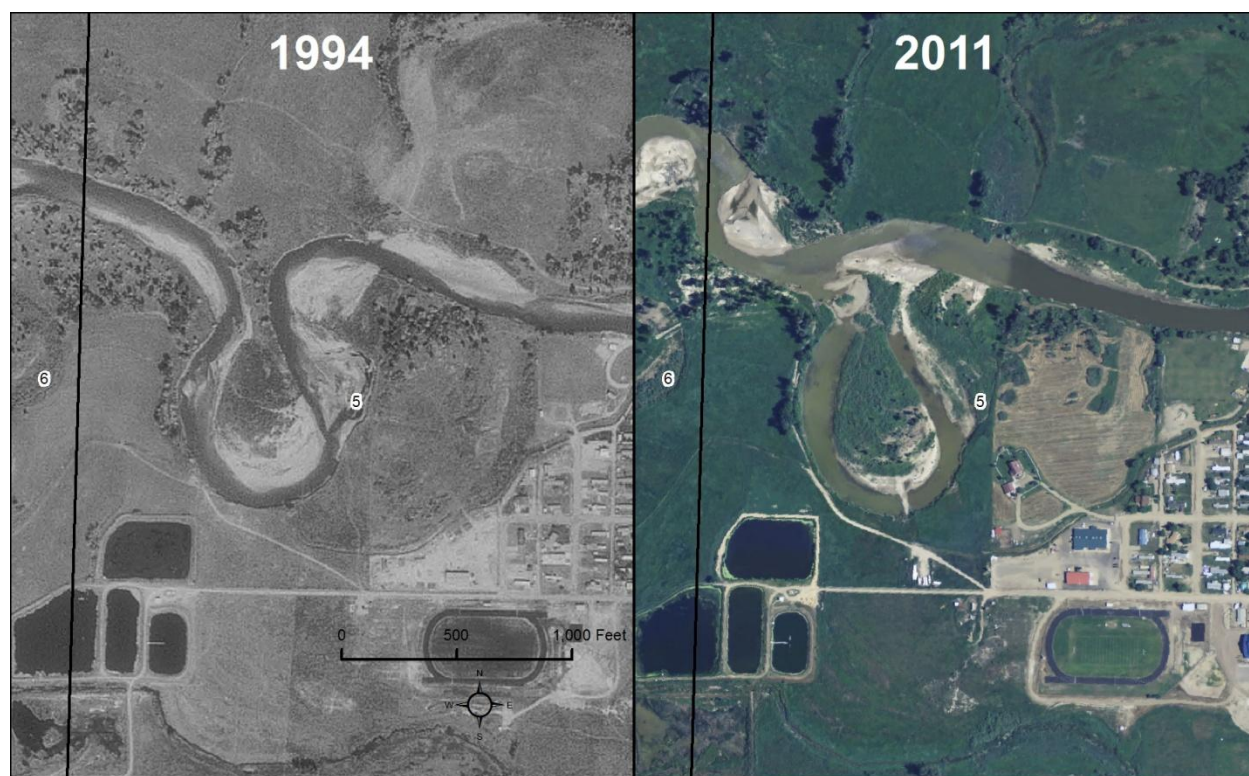


Figure 8 Meander in 1994 and 2011

3.3.2.1 *Alternative 1 – No Action*

Impacts from channel instabilities will persist under the No Action Alternative. Channel impairments, such as short transverse riffle bars, central bar deposition, chute cutoffs, down-valley meander migration, shallow pools, and channel blockages from irrigation diversions will continue.

Sedimentation issues associated with the channel condition will continue to impact aquatic habitat, the operation and maintenance of irrigation diversions, and the Baggs' water infiltration gallery. The current sediment supply yield due to bank erosion was estimated to be 8,978 tons per year for the reach, or an average rate of 0.374 tons per year per foot and this trend is expected to continue. The predicted annual sediment supply throughout the reach will continue to exceed the sediment transport capacity of the river and in comparison to stable reference conditions the erosion rate is at least two orders of magnitude greater than the potential stable condition. Accelerated bank erosion will continue to result in the loss of riparian zones, agricultural lands, and aquatic and wildlife habitat.

3.3.2.2 *Alternative 2 – Proposed Action*

Stream restoration activities outlined in the proposed action will achieve a substantial benefit for the environment as well as the agricultural and municipal resources in the area. Alternative 2 will re-establish the natural channel geometry to a Rosgen classification C-4 channel (low gradient, meandering system with point bars, pools/riffles and a well-developed floodplain). The proposed action will reduce local sediment supply by 97 percent (sediment supply yield due to bank erosion is estimated to be 229 tons per year under Alternative 2), stabilize the channel, enhance aquatic and off channel habitat, improve the riparian corridor, and reduce maintenance of in-stream infrastructure.

Under Alternative 2, oxbows will be created in areas where the channel geometry will be restored with structural components (rock structures) to form a stable stream section. This stable section will allow for increased sediment transport, thus decreasing the aggradation and point bar formation that leads to lateral channel migration. Cross vane structures and J-hooks are designed to prevent down cutting and channel entrenchment and will maintain connectivity with the flood plain that under the current situation becomes lacking once the channel becomes entrenched. As a result, the oxbows created will maintain their hydraulic connectivity to the main stem of the river, and will therefore provide flood energy dissipation and wetland and aquatic habitat for numerous wildlife species.

Impacts due to an increase in sediment will be short term and limited to the construction phase of the project (see Section 3.11). Construction will be completed during the low flow period from July through late fall/early winter when natural turbidity levels are at the lowest during the year. Turbidity levels during normal spring run-off periods are considerably higher than those expected during construction.

3.4 INFRASTRUCTURE

Analysis Area: The analysis area for infrastructure includes the project area and the Little Snake River-Willow Creek watershed. The in-stream infrastructure present in the project area is summarized below and depicted in Figure 11.

3.4.1 Adams Ditch Diversion

The existing diversion consists of steel pipe piling spaced across the channel to accommodate installation of flashboards. However, some of the steel piling is gone and the diversion is now achieved by annually constructing a gravel dam across the channel. The diversion is regulated by a 36-inch diameter slide gate attached to a timber plank headwall. The gate and wall are located about 100 feet from the left bank of the channel.

Backwater effects from the original diversion structure have caused considerable sediment accumulation upstream resulting in a high width-to-depth ratio and bar-braided channel through the deposition (Figure 9). Currently, the sand and gravel materials dredged and placed in the diversion dam provide a local increase in the sediment supply which deposits in the channel downstream. The diversion is contributing to localized sedimentation impacts and impairing the physical and ecological functions of the river channel.



Figure 9 Sediment accumulation above Adams Diversion

3.4.2 Baggs Ditch Diversion

The structure consists of a channel spanning weir with a 40 feet wide by 4 feet deep notch to allow sediment transport during high flows. The weir is constructed with corrugated interlocking sheet piling and metal assemblages in the notch to allow placement of flashboards during irrigation season. For several years now, the notch in the weir has not been functional enough to allow for placement of the flashboards and consequently, the notch has been modified with a permanent plug (Figure 10). The diversion is regulated by a slide gate attached to a concrete inlet structure with a trash guard. The diversion inlet is in excellent condition and located on the right bank of the channel.

Historically, the Baggs Diversion has been a seasonal barrier to fish migration. Owing to recent operations and maintenance modifications, the structure has become a permanent fish barrier and has impacted sediment transport characteristics. Additionally, further damage to the weir has occurred due to debris and sediment loads and is in a rapidly deteriorating state.



Figure 10 Baggs Diversion with plugged notch, damaged weir crest, and gravel dam

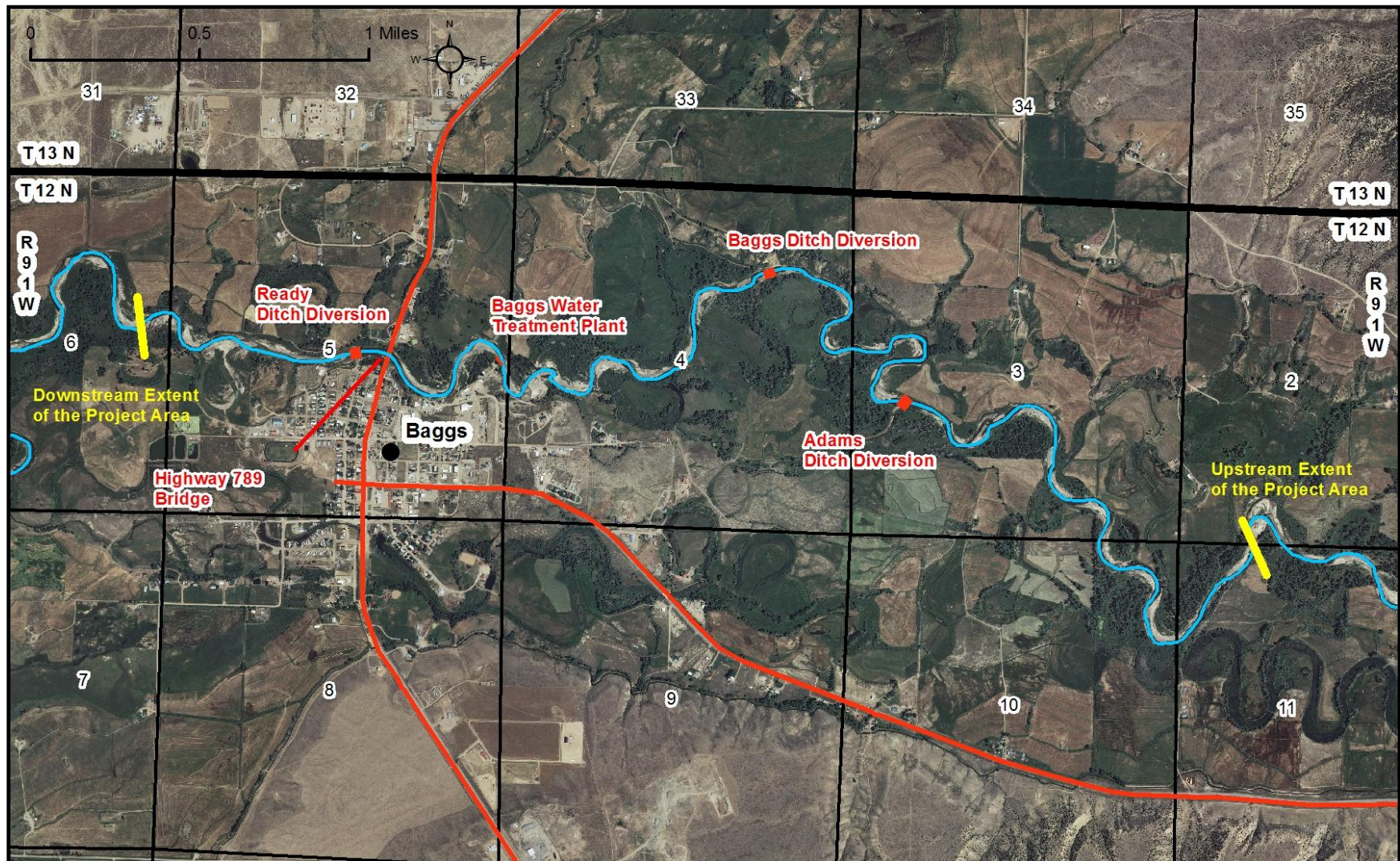


Figure 11 In-stream infrastructure

3.4.3 Ready Ditch Diversion

The diversion spans the entire channel and is constructed of miscellaneous materials (Figure 12). Steel upright components and permanent flashboards create the crest of the weir above the channel bed. The diversion is regulated by a 24-inch diameter slide gate attached to a metal frame. The gate is located about 100 feet from the left bank of the channel.



Figure 12 Ready Ditch Diversion

This diversion structure poses several impacts to the project area and stream corridor. The backwater effect from the weir has reduced the rivers sediment transport capacity and resulted in sediment deposition and failure of the Town of Baggs' water infiltration gallery. In addition, flooding problems have increased through the Town of Baggs due to the backwater effects. The structure is also a major year-round barrier to fish migration.

3.4.4 Town of Baggs Water Infiltration Gallery

The infiltration bed consists of gravel and perforated pipe buried below the channel bed surface. A channel spanning rock bed sill is located upstream of the gallery to provide grade control and prevent excessive scour. A concrete manhole and piping for raw water intake and the manholes for the infiltration bed piping are located along the left bank of the river. The raw water intake for the water treatment plant has been in service for several years; however, the infiltration gallery was recently reconstructed (work completed in February of 2012).

3.4.5 State Highway 789 Bridge

The bridge foundation includes several concrete piers in the active channel and armored abutments on both banks. Currently, the approaching road embankments confine the floodplain. The structure frequently accumulates debris at the pier caps and periodically has trapped large woody debris along the deck stringers during high flows resulting in emergency maintenance efforts (Figure 13).



Figure 13 State Highway 789 Bridge

Apparently the orientation of the bridge was originally constructed to

be fairly perpendicular to the channel, although lateral migration of the channel has skewed the flow approach angle to roughly 45 degrees. However, the bridge is not on the state highway department's list of scour sensitive bridges

3.4.5.1 *Alternative 1 – No Action*

The impacts caused by existing infrastructure will remain the same or worsen under the No Action Alternative. Existing irrigation diversions will continue to obstruct fish passage and cause aquatic habitat fragmentation. Irrigation diversions will not be replaced, or modified, and cross-vane rock structures will not be installed; thus, sediment transport will not be improved and aquatic habitat will not be increased. The Town of Baggs' water treatment plant infiltration gallery will continue to be impacted by sediment problems. Under this alternative, the construction of annual gravel diversion dams will still be necessary to divert irrigation water and associated sediment accumulation will persist. In addition, debris will continue to collect at the pier caps of the Highway 789 Bridge and this will likely necessitate emergency maintenance during high water.

3.4.5.2 *Alternative 2 – Proposed Action*

Impediments and negative impacts caused by infrastructure in the project reach will be attenuated under the Proposed Action Alternative. The proposed action includes removing, or modifying, all of the existing irrigation diversion structures within the reach and providing cross-vane rock replacement structures. Existing diversion infrastructure to be modified will accommodate the form and function of the cross-vane structures and will be utilized for additional grade control beneath the vanes.

The improvements and alterations to the diversion structures included in the proposed action will reduce sediment supply, improve sediment transport, and reduce in-stream maintenance activities. Installing low maintenance cross-vane rock diversion structures will eliminate the need to construct temporary gravel diversion dams on an annual basis, thus reducing local sediment problems and degradation of aquatic habitat. The capability of the cross-vane structures to transport sediment during high flows, divert irrigation water during low flows, and create flow diversity will enhance the physical and biological functions of the river system. The proposed cross-vane diversions will also increase habitat, accommodate fish passage, and eliminate fragmentation. Materials to be used and incorporated into the cross-vanes will consist of inert products and sound quality quarried stone.

Additional cross-vane rock structures are included in the proposed action at the Highway 789 Bridge crossing to direct woody debris through the piers in order to reduce accumulations and flooding risks. This will allow for greater passage of large woody debris and floating trees under the bridge, thereby reducing debris damage that threatens the bridge and results in emergency closure and debris clearing operations during high water. In 1997, an ice dam also piled up against the bridge piers causing minor flooding in the Town of Baggs. Changes in flow orientation (thalweg), increased velocity, and channel morphology should remediate these problems in the future.

The Town of Baggs' water treatment plant infiltration gallery will benefit from a reduction in sediment. As stated above, the water infiltration gallery was rehabilitated and completed in February of 2012 and no direct improvements to the infiltration gallery are included in the proposed action.

Impacts due to an increase in sediment associated with replacing and modifying diversion structures will be short term and limited to the construction phase of the project (see Section 3.11). Construction will be completed during the low flow period from July through late fall/early winter when natural turbidity levels are at the lowest during the year. Turbidity levels during normal spring run-off periods are higher than those expected during construction.

3.5 SOCIOECONOMIC RESOURCES

Analysis Area: The analysis area for socioeconomic resources is Carbon County.

The project area is situated in the southern part of Carbon County, Wyoming. Carbon County is a rural county in south-central Wyoming with a total population of 15,885.⁴ The Little Snake River flows west then south and the project area is in close proximity to Colorado. The Town of Baggs is located within the project area and has a population of 342 people.⁵

Carbon County employment is well-distributed among a number of different categories. Education, health care, and public administration occupations employ over 28 percent of the workforce, while the agricultural and construction sectors employ 10 percent each.⁶ Over one-quarter of the workforce is employed in the public sector. Total wages in Carbon County declined between the second quarter of 2010 and 2011—only one of two Wyoming counties to experience a drop. Total employment and average weekly wages also fell during the period.⁷

In most socioeconomic categories, statistics for Carbon County and the project area are comparable to the State of Wyoming (Table 6). However, Carbon County is more rural and has a larger Hispanic population than the rest of the state. Income levels are higher than the state, but employment growth and in-migration were weak during the most recent data collection period. The region has a strong natural resource industry base, where ranching and energy development are important economic activities.

Table 6 Social and Economic Statistics for Carbon County and Wyoming⁸

Social Statistics	Carbon County	Wyoming
Land Area (mi ²)	7,898	97,093
Persons/mi ²	2.0	5.8
Population	15,885	563,626
Population change (2000-2010)	1.6%	14.1%
White (not Hispanic)	79.8%	85.9%
Hispanic or Latino	16.8%	8.9%
American Indian	1.0%	2.4%
Economic Statistics	Carbon County	Wyoming

⁴ US Census Bureau. State and County Quick Facts – Carbon County, WY. 2010 Census

⁵ Ibid.

⁶ Ibid.

⁷ WY Dept. of Workforce Services. Wyoming Quarterly Census of Employment and Wages (QCEW) - Second Quarter 2011.

⁸ US Census Bureau. 2010 Census.

Households	6,205	217,688
Persons per household	2.27	2.44
Median household income	\$56,565	\$53,802
Persons below poverty level	8.2%	9.8%
Home ownership rate	71.3%	70.2%

3.5.1 Alternative 1 – No Action

The social and economic condition would remain the same under the No Action Alternative. Under this alternative, bank erosion and resulting impacts to the town's water treatment plant and irrigated agriculture would continue.

3.5.2 Alternative 2 – Proposed Action

The effects analysis evaluated both the economic and social aspects of the project. Positive economic impacts would include reduced water treatment costs for the Town of Baggs and lower property protection costs for affected private landowners. The proposed action is also expected to have a positive impact on the local economy through the hiring of local contractors.

Beyond summary statistics, it is reasonable to assume that landowners adjacent to the river and nearby residents have a stake in the stability and health of the river system and would experience benefits from its restoration (recreation, fishing, etc.). These benefits would accrue regardless of race or income status.

3.6 VEGETATION

Analysis Area: The analysis area for vegetation is the project area.

The project area has both an upland (rangeland) and riparian component. As the river winds through the project area to the Colorado-Wyoming State line, the density of vegetation in the riparian and upland areas varies due to a change in average annual precipitation, gradient, and geographic location.

In the riparian area that adjoins the river there is a mixture of narrow leaf cottonwood gallery forest, irrigated cropland, and wetlands. The riparian area is expanded by many irrigation water delivery systems (ditches and canals) and irrigated croplands, and return flows adjacent to the river channel within the project area. The narrow leaf cottonwood gallery forest is found directly adjacent to and adjoining the river, and in adjoining areas subject to periodic flooding that are not suitable for agriculture. Numerous willow species, green ash, hawthorn, dogwood, and snowberry are also found within the cottonwood gallery forest. Other introduced native trees, such as silver maple, poplar, and golden willow can be found growing in the riparian-dependent area around or near farmsteads and homes. Other native shrubs including chokecherry, hawthorn, rosehip, and buffaloberry are present and scattered in the margins between, and among the forested area, of the riparian zone and developed irrigated lands. Both native and introduced perennial grasses cover the soil within the forested area.

Wetlands can also be found adjoining the river in the riparian area. Typically, these floodplain wetlands are created by the extreme oxbow creation regime of the river. Many of the existing wetlands have been

invaded by common cattails with some areas supporting small native reed populations and open water. The riparian area is subject to high groundwater levels due to the irrigation of the pastures and the river; in turn supporting active wetlands and sloughs through which water flows during high runoff events. The sloughs follow historic channels that migrated across the riverine floodplain.

Directly above the riparian area in elevation lie the uplands, which are characteristically drier and of a vastly different vegetative regime commonly known as rangeland. Rangelands that are subject to adequate amounts of precipitation during the growing and non-growing season provide habitat to both livestock (cattle, sheep, horses) and wildlife. Sagebrush steppe and Utah juniper woodlands with native perennial grass and forbs dominate the uplands both north and south of the riparian area that adjoins the river.

Federally listed threatened and endangered plant species are discussed in Section 3.9.

3.6.1 Alternative 1 – No Action

Under this alternative there would be a continued loss of riparian habitat, especially old growth cottonwood gallery forest, resulting from excessive lateral channel migration. In addition, due to the lack of hydrologic connection between the Little Snake River and cut off oxbows, there would be diminished function and loss of wetland riparian vegetation.

3.6.2 Alternative 2 – Proposed Action

An increase in the total acres of riparian vegetation will result under Alternative 2. The current active river channel has an average width of 180 feet with sand and gravel bars and no perennial vegetation. After project implementation the average active channel width in the project area would be 155 feet and the average difference of 25 feet will be added to the bankfull discharge bench adjacent to the river channel. The bank full discharge benches will be seeded and planted with willow cuttings and sod mats, and cottonwood trees will readily regenerate, resulting in an increase of approximately 25 acres of cottonwood and willow riparian habitat when compared to the No Action Alternative.

The proposed action would provide greater stability to the river channel and through the construction and revitalization of historic oxbow channels would continue to provide wetlands and the maintenance of groundwater in the floodplain. Whole mature cottonwood trees, along with trees harvested in other areas as part of an ongoing aspen generation projects carried out by the LSRCD, would be used during the construction phase of the project. The project would use many willow plants harvested and transplanted to improve and armor constructed banks as part of the project. Cottonwoods, willows, and other native vegetation will regenerate and re-establish on disturbed sites adjoining the actual construction zone and their use and harvest would not cause adverse environmental effects.

The direct effects on vegetation would be of short duration, including impacts to soil resources.

3.7 INVASIVE PLANT SPECIES

Analysis Area: The analysis area for invasive plant species is the project area.

Table 7 provides the invasive species of concern that have been inventoried within the flood plain(s) of the project area and estimated occurrence (Sheehan pers. comm.).

Table 7 Invasive Plant Species of Concern and Estimated Occurrence in the Project Area

Species	Occurrence
Canada thistle (<i>Cirsium arvense</i> L.)	Common
Leafy spurge (<i>Euphorbia esula</i> L.)	Common
Hoary cress (<i>Cardaria draba</i> and <i>Cardaria pubescens</i> (L.) Desv.)	Common
Perennial pepperweed (<i>Lepidium latifolium</i> L.)	Less Common
Ox eye daisy (<i>Chrysanthemum leucanthemum</i> L.)	Trace
Yellow toadflax (<i>Linaria vulgaris</i> L.)	Less Common
Common burdock (<i>Arctium minus</i> (Hill) Bernh.)	Less Common
Houndstongue (<i>Cynoglossum officinale</i> L.)	Less Common
Russian olive (<i>Elaeagnus angustifolia</i> L.)	Trace
Common tansy (<i>Tanacetum vulgare</i>)	Trace

The aforementioned species are listed are on the Wyoming Weed & Pest Control Act Designated List, *Designated Noxious Weeds* W.S.11-5-102 (a) (xi) and *Prohibited Noxious Weeds* W.S. 11-12-104. Noxious weeds are opportunistic plant species that readily invade disturbed areas. Newly established infestations, if left un-checked, can often produce monocultures which can replace native plants in a plant community.

3.7.1 Alternative 1 – No Action

This alternative would have no increased net effect beyond weed infestations or spread that has already been identified by the CCWP. Under this alternative there are many factors that have and will continue to contribute to the spread of noxious weeds within the flood plain of the project area; these include floods, recreational use, and wildlife.

3.7.2 Alternative 2 – Proposed Action

Surface-disturbing activities such as those identified in the proposed action provide an opportunity for weed spread and establishment. Thus monitoring of noxious weeds would occur before and after construction occurs. An integrated approach suggested by CCWP will be undertaken for preventing, controlling, and monitoring any new spread of invasive plant species. The integrated approach will include options for chemical, mechanical, and biological treatments. Management plans will be implemented on a site-by-site basis depending on the species involved and private landowner involvement. In addition, the CCWP suggests that private landowners adjacent to the project area work with the CCWP in developing a noxious weed management plan in case noxious species spread to their lands as a result of this project.

The CCWP has established strong working relationships with all landowners involved in the project area and the spread of noxious weeds should be minimal because both landowners and project managers have been diligent in their efforts in protecting the natural resources of the Little Snake River (Sheehan pers. comm.).

3.8 WILDLIFE RESOURCES

Analysis Area: The analysis area for wildlife resources is the project area.

3.8.1 Ungulates

The project area includes ungulate crucial winter range as designated by the WGFD. However, a majority of the Little Snake River valley winter range use in this area occurs within the sagebrush/mountain shrub communities on the flats above the project area and calving grounds are located in higher elevations (Mong pers. comm.). Specifically, one mule deer herd (Baggs herd - MD427), two pronghorn herds (Baggs herd - PR438; Bitter Creek herd - PR414), and one elk herd (Sierra Madre - EL425) have a history of traversing crucial winter range that lies within the project area boundary. Of the three species, mule deer have the highest patterns of use associated with the designated crucial winter range, the Little Snake River, and its associated riparian habitat. Specific mule deer migration routes within the project area have not been documented, although anecdotal information suggests that mule deer do cross the river. Pronghorn use of the riparian areas associated with the river is relatively small in comparison to upland habitat use within the crucial winter range. Elk use within the project area increased over the last 10 years but still remains relatively low (Mong pers. comm.).

3.8.1.1 *Alternative 1 – No Action*

No impacts to ungulates are expected under Alternative 1 (Mong pers. comm.). Although bank erosion and channel widening will continue, river crossings will still accommodate animal movement.

3.8.1.2 *Alternative 2 – Proposed Action*

River-crossing locations for all three ungulate species may be altered slightly due to changes in riffle and run locations, predominately during periods when the river has not completely frozen over. This does not pose a major concern because it is anticipated that frozen river crossings will still accommodate animal movement during winter months.

3.8.2 Avian

Formal waterfowl surveys along the Little Snake River have been limited primarily to USFWS hunter harvest surveys and WGFD Canada goose population estimates. Mallard, blue-wing teal, green-wing teal, northern pintail, northern shoveler, and gadwall are the primary waterfowl species found throughout the area. Historic WGFD waterfowl surveys, pre-dating 1999, captured an abundance of "divers" using large oxbow lakes located west of Baggs (Roberts pers. comm.). Identified divers included redhead, bufflehead, ruddy duck, and canvasback. Timing of surveys suggested that they are likely migrants; however, there are documented observations of dabbling and diver nesting within the wetlands north of Baggs on Muddy Creek. Wood duck are readily observed near oxbow lakes surrounded by established cottonwood gallery forests. Common merganser populations foraging on river crustaceans and fish appear to be maintaining a stable population (Roberts pers. comm.).

The Wyoming Bird Conservation Plan (Nicholoff 2003) identifies "Plains/Basin Riparian" as being the second highest priority habitat type in Wyoming when considering breeding, migratory, and winter habitat use. The project area is likely to host Lewis's woodpecker, willow flycatcher, Cassin's kingbird (northern extent of its range), and MacGillivray's warbler (Lyon-Holloran pers. comm.). Local interest

species include Lazuli bunting and Bullock's oriole, which are common in the Little Snake River valley. Bald eagle, Swainson's hawk, and other raptors regularly nest and roost in the area.

Mountain plover is a terrestrial shorebird that inhabits open flatlands with sparse vegetation averaging eight inches in height. This species is found on dry shrub lands, short-grass prairie, barren agricultural fields, and other sparsely vegetated areas. These habitat requirements are not found within the floodplain of the Little Snake River.

3.8.2.1 *Alternative 1 – No Action*

Taking into consideration the statewide decline of quality cottonwood gallery forests and associated riparian communities, negative impacts to priority avian populations are expected under Alternative 1. Reduced fluvial sediment transport associated with impaired channel processes is causing excessive sediment deposition within the active river channel. This excess sedimentation typically impacts pool habitat and leads to point bar formation—which results in accelerated lateral migration of the river channel. Therefore, bank erosion is occurring in important cottonwood galley forest in many locations along the river corridor and much of this important habitat type is being lost to the active lateral river migration. Loss of cottonwood gallery forest in the project area during the last three years has been roughly 15 acres, or an average of five acres a year of mature cottonwood gallery forest with a willow shrub scrub understory. This comprises some of the best avian habitat for riparian obligate species.

3.8.2.2 *Alternative 2 – Proposed Action*

The proposed action would stabilize the channel and prevent further degradation of the cottonwood gallery forest. In the long term, restoring hydrology within the 1.5 to 2-year flood plain will result in the deposition of fine sediment, which will promote cottonwood recruitment and improve cottonwood gallery health and vigor, thus providing habitat to species using that habitat type. Stabilization of the river channel and reclaiming the newly constructed banks with willow and cottonwood transplants, willow cuttings, and sod mats will result in a net increase of approximately 14 acres of riparian habitat.

Efforts to restore hydrology and riparian habitat would also be beneficial to waterfowl. Yet the degree of mechanical habitat manipulation that occurs within existing oxbow wetlands may shift and diversify avian species composition. For example, excavation of oxbow wetlands deeper than 18 inches would promote the use of the wetland by divers while maintaining shallower areas for dabblers. Therefore, it is important to ensure that wetlands are enhanced or maintained for the area's diverse waterfowl community.

Construction activities that require cottonwood harvesting will alter bird use within that specific area. In these locations, use of the area will shift to bird species that prefer greater edge rather than cavity-nesting species that prefer dense cottonwood stands.

All habitat work must comply with the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. A review of raptor nest locations and winter roosts determined that numerous nest sites have been documented throughout the valley and that no critical roosts have been identified (Deibert pers. comm.; Mong pers. comm.; Woolley pers. comm.). Construction activities will be planned and scheduled to avoid and/or minimize disturbance during the primary nesting season for migratory birds and will occur from mid-July through December. During any one year no more than 3,000 feet of river channel will be

under construction at any one time in the roughly 6-mile reach covered under this EA. There are approximately 2,200 acres of cottonwood gallery forest in the project reach and less than 5 percent of these acres will be accessed for harvesting of cottonwood trees. Most of the harvesting of mature cottonwood trees will occur outside the nesting season. No more than 40 acres will be harvested in any one year. Initial construction activities in late July and August during nesting season will consist of channel and rock work. Only minimal disturbances to riparian areas will occur during this time. On-site habitat and bird surveys will be conducted in areas that may be disturbed by cottonwood harvesting activities during the nesting season with attempts to avoid occupied areas during nesting season. If construction activities are found to be impacting migratory bird nesting in a reach, additional surveys will be used to direct construction activities to areas with less likelihood to impact such species.

In areas where toe wood will be used for bank stabilization, local trees sources will be supplemented with material outside of the project boundary. No trees will be harvested around active or inactive raptor nests for either the local or off-site tree material.

3.8.3 Reptiles and Amphibians

Baseline reptile and amphibian surveys conducted by the WGFD in riparian habitat between Savery and Baggs in 2009 indicated the presence of native, frogs, gartersnake, and salamander. Turtle species, not native to the area, were not observed. Most notable is the presence of northern leopard frog and smooth greensnake, which are both Wyoming Species of Greatest Conservation Need (WGFD 2010). Adult northern leopard frogs commonly forage along the main channel of the river. Breeding typically occurs in oxbows, side channels, and ephemeral ponds with low predatory fish densities. Smooth greensnake habitat within the project area includes both open, damp, grassy areas and areas that include grasses interspersed with downed woody debris that provide both cover and invertebrate foraging opportunities (Walker pers. comm.).

3.8.3.1 *Alternative 1 – No Action*

No impacts to reptile and amphibian populations are expected under Alternative 1.

3.8.3.2 *Alternative 2 – Proposed Action*

There will be short term localized habitat disturbance associated with the proposed action. This disturbance will, for the most part, occur during construction activities. Most adult frogs will likely displace, yet if nearby habitat remains undisturbed they will re-colonize rather quickly. The timing of construction, due to a variety of constraints including migratory bird nesting, will preserve and protect egg masses and individuals in the process of undergoing metamorphosis.

Opportunities for restoration of hydrology within the 1.5 to 2-year floodplain will improve breeding habitat conditions for northern leopard frogs that rely on ephemeral water. Occasional tree harvest, as needed for river restoration techniques, will provide openings within the mature cottonwood gallery. This will promote grassland development that can improve habitat conditions for both smooth greensnakes and northern leopard frogs. Smooth greensnake habitat will be improved by downed woody debris (from the tops and limbs of harvested cottonwood trees) that will be scattered in grassland areas, thereby providing the snakes with both cover and invertebrate foraging opportunities.

3.9 FEDERALLY LISTED THREATENED AND ENDANGERED SPECIES

There are several special-status wildlife and plant species that could potentially exist, or historically existed in the project area.

Analysis Area: Unless otherwise noted the analysis area for federally listed threatened and endangered species is the project area.

3.9.1 Black-footed Ferret (Endangered)

Black-footed ferrets historically inhabited prairie dog towns throughout the State of Wyoming. The black-footed ferret is found almost exclusively in prairie dog colonies in shrub lands, sagebrush-grasslands, and grasslands. It is dependent on prairie dogs for food and all essential aspects of its habitat, especially prairie dog burrows where it spends most of its life underground. No prairie dog towns exist with the project area and floodplain and riparian habitat is not conducive for prairie dog colonies. Consequently black-footed ferrets and their associated habitat needs are not present.

3.9.1.1 *Alternative 1 – No Action*

No impacts to black-footed ferrets are expected under Alternative 1.

3.9.1.2 *Alternative 2 – Proposed Action*

The proposed action would not negatively impact black-footed ferrets since they do not occur in the project area.

3.9.2 Canada Lynx (Threatened)

Canada lynx were listed as threatened species under the ESA in the contiguous United States on March 4, 2000. In Wyoming, the lynx lives in subalpine/coniferous forest of mixed age and structural class. Proposed critical lynx habitat includes boreal forest landscapes of Freemont, Lincoln, Park, Sublette, and Teton Counties. The project area lacks habitat preferred by lynx.

3.9.2.1 *Alternative 1 – No Action*

No impacts to lynx are expected under Alternative 1.

3.9.2.2 *Alternative 2 – Proposed Action*

The proposed action would not negatively impact lynx since they do not occur in the project area.

3.9.3 Greater Sage-grouse (Candidate)

Greater sage-grouse (sage-grouse) populations have been declining since at least the 1960s across their habitat range. Present and historic use of the area by sage-grouse included nesting within the upland sagebrush plant communities or brood rearing along secondary and tertiary tributaries that contribute to the Little Snake River. The project area is not located within habitat designated "Greater Sage-Grouse Core Area" as identified by the State of Wyoming in 2011. Moreover, areas that provide an abundance of overhead cover are typically avoided by sage-grouse and therefore it is highly unlikely that any treed areas found in the Little Snake River floodplain will be suitable sage-grouse habitat (Deibert pers. comm.). Alfalfa or native hay meadows adjacent to the project area may be used by sage-grouse.

3.9.3.1 *Alternative 1 – No Action*

No impacts to sage-grouse are expected under Alternative 1.

3.9.3.2 *Alternative 2 – Proposed Action*

The proposed action would not negatively impact sage-grouse. Habitat work will be primarily contained within the active channel and floodplain (low terrace). Habitats commonly found within these areas include wetlands with associated plant communities not preferred by sage-grouse. Human activity in and around hayfields will remain similar to what it has been historically.

3.9.4 Yellow-billed Cuckoo (Candidate)

The yellow-billed cuckoo is found mainly along the eastern edge of Wyoming, with a few scattered observations west of the Continental Divide (Wiggins 2005). There have been no recorded observations of yellow-billed cuckoo within the Little Snake River valley (Arnett pers. comm.). Cervoski et al. (2001) suggested that the yellow-billed cuckoo in Wyoming required a minimum patch size of 25-acre cottonwood forests with an average width of 100 meters. A dense shrub understory is necessary for both successful nesting and foraging. A relative absence of the required dense understory is potentially the limiting factor for yellow-billed cuckoo along the Little Snake River.

3.9.4.1 *Alternative 1 – No Action*

No impacts to yellow-billed cuckoo are expected under Alternative 1.

3.9.4.2 *Alternative 2 – Proposed Action*

The yellow-billed cuckoo is associated with relatively expansive stands (>600' breadth) of mature cottonwood-willow riparian corridor habitat with a healthy dense understory for foraging. Not many of these true cottonwood galleries exist within Wyoming's riparian corridors. Examples of this limited habitat are associated with reservoir tail water areas on larger river systems like Bighorn/Yellowtail Lake on the Big Horn River. The cottonwood gallery within the Little Snake River floodplain can be categorized as narrow, sparse and lacking adequate understory to effectively attract and hold yellow-billed cuckoos.

Riparian stabilization and the restoration of hydrology within the natural 1.5 to 2-year floodplain should encourage the growth of willow, maintain existing mature cottonwood gallery forest, and encourage recruitment of cottonwood. This could improve habitat availability for western yellow-billed cuckoos that prefer to nest in dense willow and cottonwood (Wiggins 2005).

3.9.5 Blowout Penstemon (Endangered)

Blowout penstemon was first discovered in Wyoming in 1996 during a survey of riparian areas in the sand dune country south of the Ferris Mountains in Carbon County. In more recent years, several thousand individual plants make up the three known Wyoming populations in the northeastern corner of the Great Divide Basin in Carbon County, near the Ferris and Seminole Mountains. The blowout penstemon is a pioneer species on sand dunes and sandy aprons at the base of mountains and ridges. The area of impact within the floodplain of the Little Snake River does not consist of sand dunes, sandy aprons, or wind carved depressions (blowouts). Likewise, there has been no documented evidence of the

plant's existence within the project area.

3.9.5.1 *Alternative 1 – No Action*

No impacts to blowout penstemon are expected under Alternative 1.

3.9.5.2 *Alternative 2 – Proposed Action*

The proposed action would not negatively impact blowout penstemon as they are not expected to occur in the project area.

3.9.6 Ute ladies'-tresses (Threatened)

Ute ladies'-tresses is a perennial terrestrial orchid associated with moist soils near wetland meadows, spring lakes, and perennial streams. The elevation range of known occurrences is 4,200 to 7,000 feet in alluvial substrates along riparian edges, gravel bars, old oxbows, and moist to wet meadows (Arft and Ranker 1998; Moseley 1998). In Wyoming, the plant occurs at four locations including Converse, Goshen, Laramie, and Niobrara Counties (Fertig et al. 2005). There are no confirmed reports of Ute ladies'-tresses in Carbon County. In addition, there are no known occurrences of Ute ladies'-tresses above 5,400 feet in the State of Wyoming (Heidel pers. comm.) and elevations within the lowest portion of the project area exceed 6,000 feet.

3.9.6.1 *Alternative 1 – No Action*

No impacts to Ute ladies'-tresses are expected under Alternative 1.

3.9.6.2 *Alternative 2 – Proposed Action*

The proposed action would not negatively impact Ute ladies'-tresses as they are not expected to occur in the project area.

3.9.7 Colorado River Fish and Designated Critical Habitat

Analysis Area: The analysis area is the Little Snake River-Willow Creek watershed.

Colorado River endangered fishes do not occupy the project area. Critical habitat is designated for endangered Colorado River fishes in Colorado and Utah and in habitat in the Yampa, Green, and Colorado River systems located approximately 60 miles downstream of the project area (Figure 14).

Upper Colorado endangered fish species include the bonytail chub, Colorado pikeminnow, humpback chub, and razorback sucker. Historically found in the upper Green River watershed of southwestern Wyoming, now considered extirpated in Wyoming with possible exception of the lower Little Snake River—considered a “rare” capture, an adult Colorado pikeminnow has been sampled downstream of Baggs. In addition, humpback chubs have been captured in the lower 10 miles of the Little Snake River located roughly 50 miles downstream of the project area (Figure 14) (USDI 2002a; USDI 2002b).

The Little Snake River provides approximately 28 percent of the Yampa River's flow and 60 percent of the Yampa River's sediment supply (Figure 14). The Yampa River Management Plan and Environmental Assessment (Roehm 2004) identified the flow contribution of the Little Snake River as important to the recovery of the Yampa River. Flows from the upper Yampa River, especially spring peak flows, were crucial to the maintenance of the Green River's “large-river” characteristics and, therefore, very important

to maintaining suitable conditions in the Green River downstream of the confluence (Holden 1980). The sediment supply of the Little Snake River is also believed to be important to the maintenance of backwater nursery areas utilized by young Colorado pikeminnow in the Green River (Smith and Green 1991).

Depletions are characterized as a permanent loss of water from the system available for threatened and endangered fish species in the Yampa River Basin associated with anthropogenic factors. Historic types of depletions are diversion of water for agricultural, industrial, and municipal purposes. Other types of depletions include evaporation from storage impoundments that may include reservoirs, ponds, and constructed wetlands and to a lesser extent changes in the plant species and/or canopy cover that may affect the amount of water consumed through transpiration.

3.9.7.1 *Alternative 1 – No Action*

Current conditions would continue under the No Action Alternative. Since Colorado River endangered fishes do not currently occupy the project area, there would be no adverse impacts. However, this alternative would not provide the long term habitat restoration needed for recruitment of Colorado River endangered fishes into this reach of the Little Snake River system. Because there are no changes in diversion of water for agricultural, municipal, or industrial purposes, there are no increased depletions associated with these activities.

3.9.7.2 *Alternative 2 – Proposed Action*

Since Colorado River endangered fishes do not currently occupy the project area, adverse impacts are not expected. Evaporation as a form of depletion will be reduced under Alternative 2. Evaporation is a function of temperature, wind speed, and surface area of the water body. Temperature and wind speed will not be changed, although surface area will be. Currently, the average channel width through the seven mile reach is 180 feet at bank full discharge and the planned design average width after restoration is 155 feet. This will result in a reduction of 21.1 surface acres of water at bank full discharge. Using pan evaporation data from the nearest location, Rock Springs Wyoming, the net evaporation equals 37.7 inches per year. This would result in a reduction of 63.3 acre feet of water loss to evaporation post construction in the project reach. While the river will not be at bank full during the entire evaporative season, the calculations do support an overall reduction in evaporative loss as a result of project activities.

Because there are no changes in diversion of water for agricultural, municipal, or industrial purposes, there are no increased depletions associated with these activities. Long term changes to riparian areas will result in some additional acres occupied by riparian vegetation. This will only result in a small increase in plant transpiration. The slight long term increase in transpiration in the project reach is well within the range of natural variation along the Little Snake River. Any changes to flow regimes in the Little Snake River associated with transpiration will be negligible and undetectable. Thus there will not be any impacts to federally listed fishes or their critical habitat in the Colorado River Basin.

The Final Programmatic Biological Opinion on the *Management Plan for Endangered Fishes in the Yampa River Basin* (USDI 2005) recognizes the Little Snake River primarily for its input of annual sediment load to the Yampa to maintain a balance of sediment transport and secondarily annual

water yield. The proposed project will not impact either of these important contributions (see Section 3.3.2.2).

The Proposed Action Alternative would fulfill certain approved Upper Colorado River Endangered Fish Recovery Program tasks under the Final Programmatic Biological Opinion on the *Management Plan for Endangered Fishes in the Yampa River Basin* including, acquire/enhance floodplain habitats, restore/maintain native fish passage at diversion structures, and restore/enhance aquatic habitats (Upper Colorado River Endangered Fish Recovery Program 2011; USDI 2005).

All habitat work will comply with the Upper Colorado River Endangered Fish Recovery Program, State Conservation Strategies for Colorado River Cutthroat Trout, and Range-wide Conservation Agreements for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker.

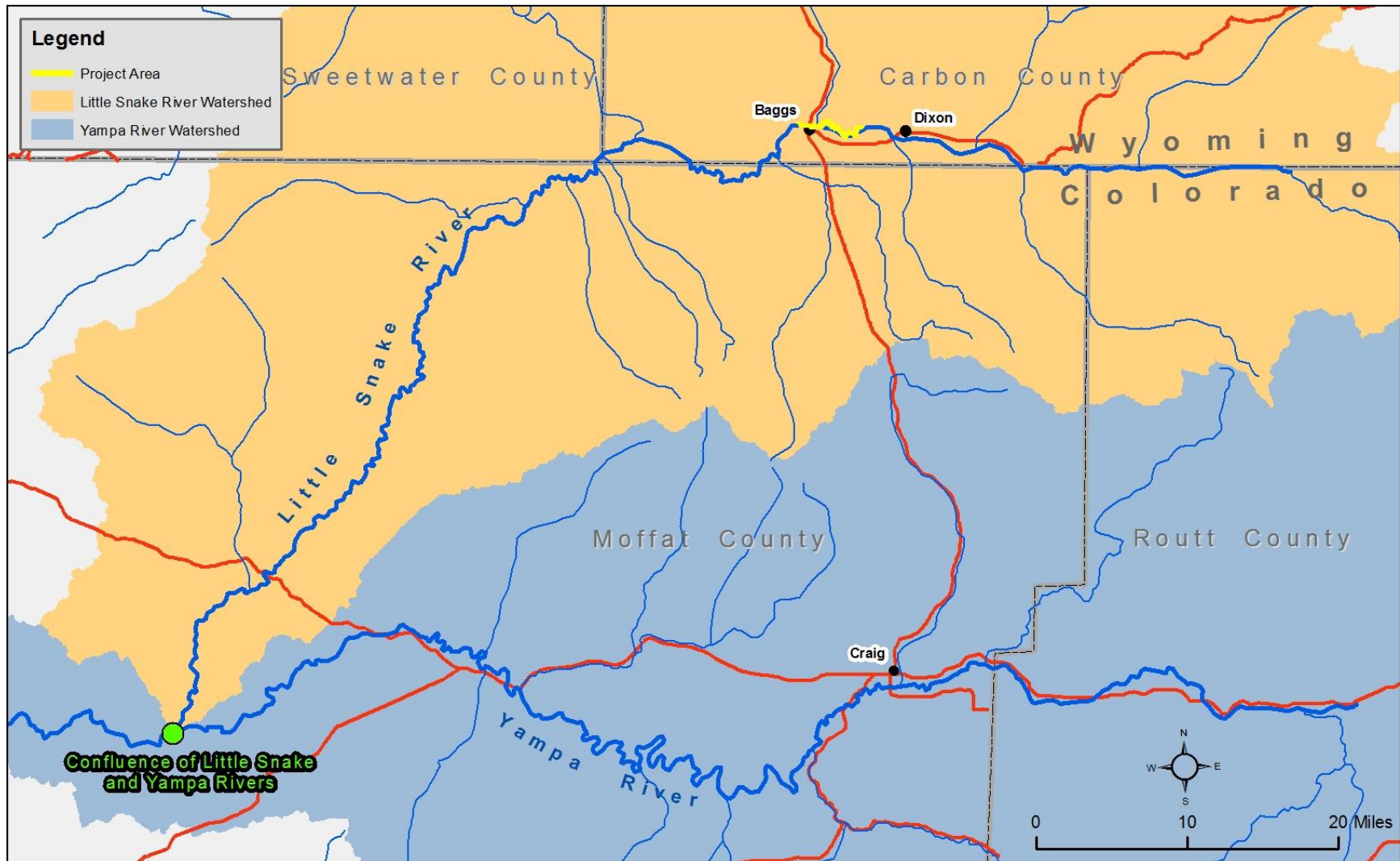


Figure 14 Confluence of Little Snake and Yampa Rivers

3.9.8 Summary of Effects Determinations

This EA will serve as the ESA Section 7 compliance document for this proposed project and also serves as a surrogate biological assessment. A biological assessment is required if listed species or critical habitat may be present in the action area and the contents of a biological assessment prepared pursuant to the Act are largely at the discretion of the action agency. Through a variety of informal consultation actions it has been determined that the Little Snake River in Wyoming does not contain the four listed endangered fish species of the upper Colorado River system or critical habitat. The following table provides effects determinations for special-status wildlife and plant species discussed in Section 3.9.

Table 8 Effects Determinations for Special-status Wildlife and Plant Species

Species	Effects Determination
Black-footed ferret	No effect
Canada lynx	No effect
Greater sage-grouse	No effect
Yellow-billed cuckoo	May affect, but not likely to adversely affect
Blowout penstemon	No effect
Ute ladies'-tresses	No effect
Colorado River fish and designated habitat	May affect, but not likely to adversely affect

3.10 AQUATIC RESOURCES

Analysis Area: The analysis area for aquatic resources is the Little Snake River-Willow Creek watershed.

Existing river conditions are typical of an altered watershed having reduced seasonal stream flows and an impaired sediment transport system. Habitat degradation resulting from accelerated lateral migration and channel incision is represented by long riffle/run patterns with reduced pool habitat, which is contributing to a declining native fish community identified in the Little Snake River Lower Basin Plan (WGFD 2011). Many once hydrologically (surface water) connected backwater areas are now perched due to channel incision receiving water at a higher magnitude flood flow, or from irrigation return flows reducing or eliminating these as fish rearing areas. Habitat conditions gradually decrease in quality moving downstream, as water temperatures fluctuate and stream flows diminish during the summer.

Based on the available habitat for sensitive native fish species and the important cottonwood/willow riparian habitat diversity used by several terrestrial and aquatic wildlife species along the Little Snake River, the WGFD Strategic Habitat Plan (2009) categorizes the river as a Crucial Habitat Area. Eighteen fish species have been documented within the Little Snake River Basin, of which eight are native to the basin, while ten species and three catostomid (sucker species) hybrid combinations are non-native (WGFD 2011).

The success of non-native aquatic species is attributed to changes in the river system that favors their survival over that of native fishes. Three non-native fish species were introduced as sport-fish: brook

trout, rainbow trout, and channel catfish. In February 2004, the Upper Colorado River Endangered Fish Recovery Program adopted a non-native fish management policy that addresses the process of identifying and implementing non-native fish management actions needed to recover the endangered fishes (Upper Colorado River Endangered Fish Recovery Program 2004). From this framework, the development of multi-state conservation agreements and basin-wide strategies for the management of non-native aquatic species has led to the cessation of all non-native species stockings and management of watershed as a wild fishery.

The WGFD State Wildlife Action Plan (WGFD 2010) has identified 180 Species of Greatest Conservation Need, a process that was developed to identify species, including low and declining populations that are indicative of the diversity and health of Wyoming's wildlife. The WGFD's Species of Greatest Conservation Need designation process is based upon its Native Species Status (NSS) classification system.⁹

Species of Greatest Conservation Need ratings are as follows for Little Snake River fishes:

- **NSS1:** Populations are physically isolated and/or are at extremely low densities throughout historic range. Extirpation appears possible. Habitat considered declining or vulnerable.
- **NSS2:** Populations are physically isolated and/or are at extremely low densities throughout historic range. Extirpation appears possible. Habitat considered stable.
- **NSS4:** Species is widely distributed throughout its native range, population status is stable, and habitat considered stable.

The Little Snake River fish assemblage upstream of Dixon, Wyoming transitions from a cold- to warm-water species assemblage because the fluvial geomorphology features of the main stem of the river and tributaries change at this point, becoming a lower gradient stream with a wider temperature range. The cold-water suite of species upstream of Dixon includes Colorado cutthroat trout (NSS2 (Ba)) and mountain whitefish (NSS4 (Bc)) (Oberholtzer 1987). The NSS2 (Ba) rating for Colorado cutthroat trout indicates a vulnerable population status and extreme limiting factors and the NSS4 (Bc) rating for mountain whitefish indicates a vulnerable population status with moderate limiting factors (Figure 15). Limiting factors include habitat, human activity levels, genetics, disease, invasive species, and climate change (WGFD 2010). The warm-water suite of species downstream of Dixon includes bluehead sucker (NSS1 (Aa)), flannelmouth sucker (NSS1 (Aa)), and roundtail chub (NSS1 (Aa)). The NSS1 (Aa) rating for all three species indicates an imperiled population status and extreme limiting factors.

⁹ <http://gf.state.wy.us/web2011>

Limiting Factors					
		a. EXTREME Limiting factors are severe and continue to increase in severity	b. SEVERE Limiting factors are severe and not increasing significantly	c. MODERATE Limiting factors are moderate and appear likely to increase in severity	d. MINIMAL Limiting factors are moderate and not likely to increase in severity
Population Status	A. IMPERILED Population size or distribution is restricted or declining and extirpation is possible	Aa NSS1	Ab NSS2	Ac NOT APPLICABLE	Ad NOT APPLICABLE
	B. VULNERABLE Population size or distribution is restricted or declining but extirpation is not imminent	Ba NSS2	Bb NSS3	Bc NSS4	Bd NOT APPLICABLE
	C. STABLE Population size and distribution is stable and the species is widely distributed	Ca NOT APPLICABLE	Cb NSS4	Cc NSS5	Cd NSS6
	D. EXPANDING Populations are expanding in number and/or distribution and the species is widely distributed	Da NOT APPLICABLE	Db NOT APPLICABLE	Dc NSS6	Dd NSS7

Figure 15 Native species status matrix¹⁰¹⁰ Modified from the Wyoming State Wildlife Action Plan, 2010

3.10.1 Alternative 1 – No Action

Current conditions would continue under the No Action Alternative. Under this alternative, seasonal and year round fish passage barriers would remain. There would be an increase in thermal impacts due to the over wide channel, low frequency of pool habitat, and lower water depth. A decrease in shading due to bank erosion and loss of cottonwood gallery forest would also occur. Channel instability coupled with accelerated lateral migration and increased sediment loading would contribute to the loss of in-stream bed features and riparian and wetland habitat. Poor stream conditions would continue to limit habitat function including foraging and nursery habitats, security cover, and spawning sites.

3.10.2 Alternative 2 – Proposed Action

The restoration of the stream channel and floodplain features would match the watershed hydrology, providing for a stable reach of channel. Fish passage would be greatly improved by the removal of physical barriers, enhanced in-stream habitat, and properly sized channel. The project is expected to increase overall fish habitat with constructed bed features, as well as provide suitable nursery and rearing habitat for juvenile fishes with the addition of constructed smaller side channels, wetlands, and backwater areas. The adjacent, shallow floodplain features created would be either directly connected to the stream channel or accessible during higher flows.

Bank shaping and in-stream rock structures will reduce hydraulic forces on the bank, thereby allowing vegetation time to grow and establish a solid root system. Once established, the wetland and riparian plant community will provide for long term stability of the site while enhancing the biodiversity of the riparian corridor. Engineered log structures will also provide immediate habitat for aquatic species and will aid with recruiting additional large wood to enhance the stream corridor.

During the construction phase of the project existing water resources will be subject to short term, localized impacts due to an increase in turbidity and total suspended solids (see Section 3.11). Since construction activities will occur during the low water stage (July through late fall/early winter), coarse material typically will not be transported beyond the immediate work site and fine materials typically will not be transported beyond one meander length. Native fishes to the system are adapted to sediment loads and while there is a concern about covering eggs in fine sediment, the work will not place during the spawning window. Thus, it is not anticipated that the Proposed Action Alternative will create any long term negative impacts.

Proposed oxbow and side channel wetlands within the project reach are designed to restore pre-existing features and habitats. The construction of wetlands will incorporate design features to limit northern pike habitat and accessibility to these habitats. To the maximum extent possible, wetland creation will follow guidelines established by the Upper Colorado River Endangered Fish Recovery Program to eliminate use by northern pike. Restored wetland features will be constructed parallel to the main river channel, thus lowering the value of these areas as northern pike nursery habitat (Hill 2004). Proposed wetland areas have been designed as shallow sites to encourage the growth of riparian woody plants (willow and cottonwood) and to discourage possible overwintering of northern pike, eliminating the need for drawdown structures. Any deepwater habitat created will be isolated from flood flows and mainstem connection points in order to prevent recruitment of northern pike in the Little Snake River (Colorado Division of Wildlife 2010). No new water depletions are anticipated.

All habitat work must comply with the Upper Colorado River Endangered Fish Recovery Program, State Conservation Strategies for Colorado River Cutthroat Trout, and Range-wide Conservation Agreements for Roundtail Chub, Bluehead Sucker, and Flannemouth Sucker. Although few Colorado River cutthroat trout occupy the Little Snake River within the lower basin (WGFD 2011), Alternative 2 will contribute to their conservation upstream in the watershed.

3.11 UNAVOIDABLE ADVERSE IMPACTS (ON ALL RESOURCES)

Project activities will result in elevated turbidity and suspended sediment levels in the Little Snake River during construction. Channel realignment and channel shaping, bank sloping and stabilization, pool excavation and rifle construction, and placement of rock structures will be performed with heavy equipment in the active river channel. Disturbance will include redistribution of river alluvium throughout the project area resulting in temporary increases in turbidity. Construction will be completed during the low flow period from July through late fall/early winter when natural turbidity levels are at the lowest during the year. Turbidity levels during normal spring run-off periods are substantially higher than those expected during construction.

As part of the Clean Water Act (CWA) Section 404 permit for this project, the Wyoming Department of Environmental Quality (WDEQ) issued a CWA Section 401 water quality certification. In September 2011, the LSRCD received a temporary increase in turbidity waiver from the WDEQ for the Little Snake River while previous river work was taking place (restoration work was completed upstream of the project area). The WDEQ authorized the LSRCD to exceed the turbidity standard for 30 days. Section 23 (a) of Chapter 1 of the WDEQ Water Rules and Regulations states, “In all cold water fisheries and drinking water supplies (classes 1, 2AB, 2A and 2B), the discharge of substance attributable to or influenced by the activities of man shall not be present in quantities which would result in a turbidity increase of more than 10 NTUs.” The data collected over the 30-day period is shown in Figure 16 (weekends were not included in the data since construction activities did not take place). While there were exceedences to the turbidity standard, there were no major impacts to the river or the Town of Baggs’ water treatment plant. It should be noted that the replacement of the town’s water treatment infiltration gallery partially overlapped with the construction upstream on the Little Snake River and this also contributed to the increase in turbidity. Turbidity associated with the planned project is expected to be less than that associated with the 2011 construction.

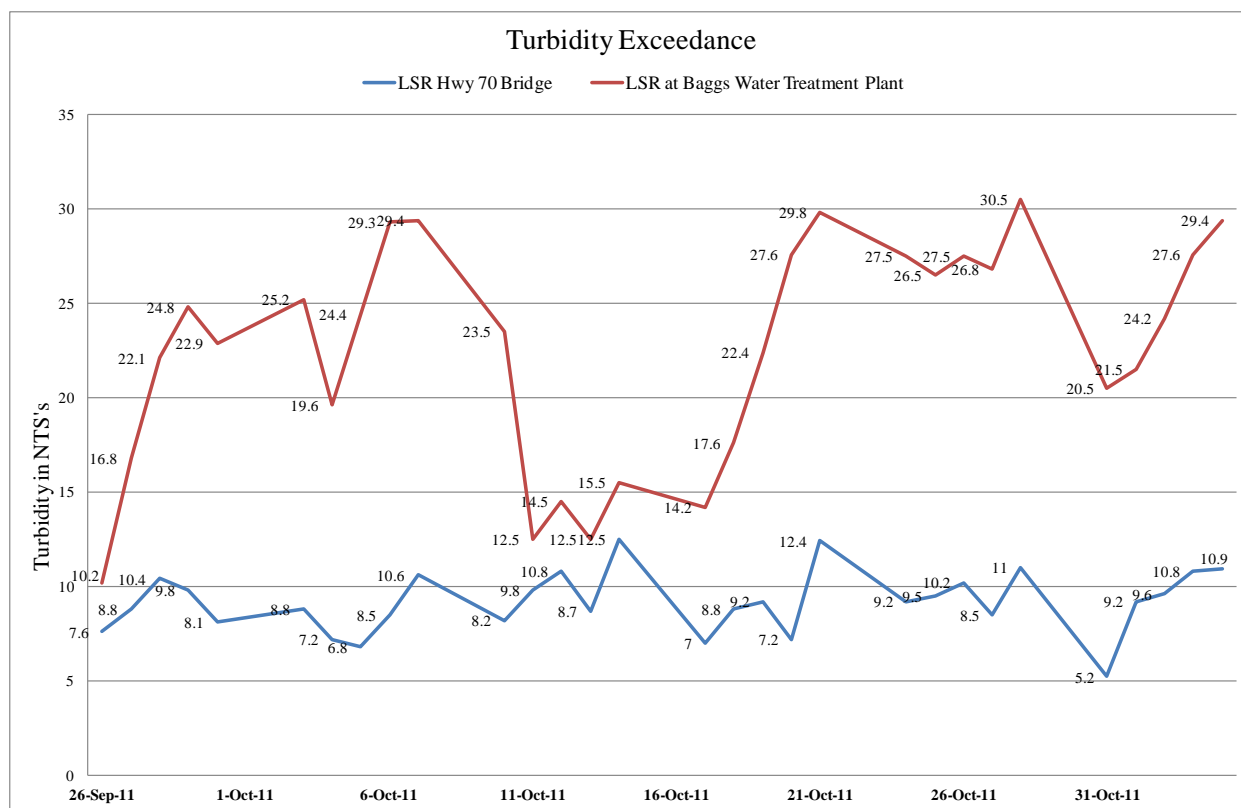


Figure 16 Temporary turbidity increases during 2011

It is anticipated that the proposed project would create turbidity standard exceedences, and the LSRCD would again work with the Town of Baggs and the WDEQ to monitor turbidity during all construction phases. The temporal increase in turbidity would be classified as an unavoidable adverse impact of the project; however, the impact would be of short duration and would be permitted to occur by the WDEQ under the CWA.

3.12 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible commitment of resources refers to a loss of non-renewable resources, such as mineral extraction, cultural resources, or to those factors which are renewable only over long time spans or at great expense, or to resources that have been destroyed or permanently removed. No irreversible commitments of resources were identified for the project.

Irretrievable commitment applies to losses that are temporary, such as use of renewable natural resources. No irretrievable commitments of resources were identified for the project.

3.13 ASSESSMENT OF CUMULATIVE IMPACTS

NEPA requires the analysis of cumulative effects, or the effects of the alternatives considered when evaluated in combination with any past, present, or reasonably foreseeable activities (40 CFR 1508.7). Cumulative effects result when the incremental effects of actions are added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions.

Cumulative effects can occur from individually minor, but collectively significant actions taking place over a period of time.

Past activities contributed to the existing condition and are considered in the affected environment. Present and reasonably foreseeable future actions are assessed along with the effects of the proposed action for each resource to determine whether significant cumulative effects may occur.

3.13.1.1 *Agriculture*

Numerous past actions, including crop rotation and grazing have occurred on adjacent agricultural lands. Sediment generated by future irrigated lands management could adversely impact irrigation ditches if Alternative 1 were implemented. Alternative 2 will have beneficial cumulative effects on future irrigated lands management.

3.13.1.2 *Cultural Resources*

While there could be indirect impacts under Alternative 1, there are no other activities planned in the project area that would have a combined effect on cultural resources. Since there are no direct or indirect effects associated with Alternative 2, there are no cumulative effects.

3.13.1.3 *Water Resources*

The area of cumulative effects analysis for fisheries resources is the Little Snake River-Willow Creek watershed. Within the analysis area, water has been diverted from the river for agricultural uses and municipal uses and this will continue into the foreseeable future. Because there is no change in diversion of water for agricultural, municipal, or industrial purposes there is no increased depletion associated with these activities.

Crop rotation in adjacent agricultural lands will likely contribute sediment to the project area under both alternatives. Given that the proposed action will reduce local bank erosion (see Section 3.3.2), and that limited crop rotation will likely take place during that timeframe, the cumulative impact of sediment supplied by crop rotation will be minimal.

The Little Snake River Basin has two perennial streams that drain into the project area. Sections of Savery Creek and Muddy Creek are listed on the WDEQ impaired waters list (Wyoming Department of Environmental Quality 2010). Portions of the lower part of Savery Creek were placed on the list for physical degradation in 1998. The LSRCD implemented a Section 319 watershed improvement project to address the issues identified. Two sections of Muddy Creek remain on the list for 2012: the section of Muddy Creek from the confluence with Red Wash upstream to the confluence with Antelope Creek (west of highway 789) and below Youngs Draw on Muddy Creek. The section from the confluence with Red Wash to Antelope Creek is listed for habitat degradation and the LSRCD is working with the WDEQ to delist this section of stream. The lower section that is listed on Muddy Creek, below Youngs Draw, has shown exceedences of the “chronic aquatic life other than fish chloride and selenium criteria.” Comments submitted to the WDEQ by the LSRCD state that selenium and chloride levels are consistent with natural baseline soil concentrations. None of these listings are cumulatively important to the proposed project.

3.13.1.4 *Infrastructure*

When considered cumulatively, Alternative 2 would compliment irrigation management in the area and reduce in-stream maintenance activities.

3.13.1.5 *Socioeconomic Resources*

Under Alternative 2, recreation and fishing opportunities would be improved over time because of stream and wetland restoration.

3.13.1.6 *Vegetation*

Rural development, removal of riparian buffers, and installation of bank armoring have affected the assemblage and function of riparian habitat in the project area. Land use practices such as irrigated agriculture and grazing have also impacted floodplain plant communities. Reasonably foreseeable actions include continued rural development, grazing, and agriculture.

3.13.1.7 *Invasive Plant Species*

There are many factors that have and will continue to contribute to the spread of noxious weeds within the flood plain of the project area; these include floods, recreation, and wildlife. The short term effects of Alternative 2 may result in weed spread and establishment in areas with surface disturbance. However, over the long term, the stabilization of river banks in the project area and the establishment of native riparian vegetation, along with weed control activities undertaken by the CCWP and LSRCD, would contribute positive cumulative effects on noxious weeds.

3.13.1.8 *Wildlife Resources*

There will be short term, localized habitat disturbance for reptiles and amphibians under Alternative 2; however, no major or long term impacts are anticipated for populations. Since there are no other activities planned in the project area that would have a combined effect on reptile and amphibian populations, no adverse cumulative impacts are expected from the proposed action.

3.13.1.9 *Federally Listed Threatened and Endangered Species*

Since there are no direct or indirect effects expected from the proposed action, there are no cumulative effects for the following species: black-footed ferret; Canada lynx; Greater Sage-grouse; mountain plover; yellow-billed cuckoo; blowout penstemon; and Ute ladies'-tresses.

The area of cumulative effects analysis for Colorado River fish is the Little Snake River-Willow Creek watershed. Although Colorado River endangered fishes do not currently occupy the project area, the proposed action would improve connectivity, habitat function, and increase available habitat including foraging and nursery habitats, security cover, and spawning sites. Since the restoration of the stream channel and floodplain features would match the watershed hydrology and provide for a stable reach of channel, cumulative effects are expected to be beneficial.

3.13.1.10 *Aquatic Resources*

The area of cumulative effects analysis for fisheries resources is the Little Snake River-Willow Creek watershed. Alternative 2 is expected to eliminate habitat fragmentation caused by existing irrigation

diversions and reverse the decline of native fish species. Since the overall effect of the proposed action is anticipated to be beneficial to native fish species and aquatic habitat in the Little Snake River, and because negative impacts from sediment are expected to be short term and negligible, cumulative effects are expected to be positive. The proposed action will also help mitigate impacts resulting from High Savery Dam.

3.13.1.11 Summary of Management History

A summary of management history is provided in Table 9 and demonstrates that relevant past, present, and reasonably foreseeable activities have been considered in the cumulative effects analysis. A review of the Medicine Bow-Routt National Forests Schedule of Proposed Actions did not identify any activities within the analysis areas.

Table 9 Management History Summary

Location	Project Name	Watershed	Landowner	Activity	Year(s)	Notes
T12N R91W Sec. 1& 2	Little Snake River Restoration Project Phases A through C	Little Snake River	Private	River restoration (channel and bend restoration with side channel and oxbow wetland creation)	2011	Finished in 2011. These past actions have been accounted for in affected environment baseline conditions.
T12N R 89W Sec. 4 & 5	Baggs Water Treatment Plant Infiltration Gallery	Little Snake River	Private	Reconstruct infiltration gallery	2011-2012	Completed in February 2012
T 12N R89W Sec.5	Removal of Diversion Structure	Little Snake River	Private	Demolition and removal	2012	Completed April 2012
Project Area	Crop Rotation in Adjacent Agricultural Lands	Little Snake River	Private	Crop rotation	Foreseeable future	Crop rotation schedules vary on adjacent agricultural lands

4. POST-TREATMENT MONITORING

In 2010, the WGFD conducted electro-fishing and fish sampling through the middle section of the six mile reach. Follow up fish sampling will be conducted in subsequent years post-treatment at WGFD discretion to evaluate fisheries effects. In addition, cooperative agreements between the LSRCD canal

companies, WGFD, Trout Unlimited, and USFWS provide access to modified diversion structures to evaluate for fish passage monitoring. Long term comparison of water quality samples will be collected and analyzed at the Baggs water treatment plant as well.

The Section 404 permit for the project requires both longitudinal and cross section monitoring for a period determined by the Army Corps of Engineers to document increased channel stability, geometry, and river morphology. Time series aerial imagery will also be used to evaluate and monitor channel stability. In addition, the use of established permanent photo points will be utilized to monitor riparian vegetation and bank stability.

5. COMPLIANCE WITH FEDERAL, STATE, AND LOCAL LAWS

The implementation of the Proposed Action Alternative would be in compliance with federal, state, and local laws and requirements imposed for the protection of the environment. A brief description of the project's compliance with applicable laws and regulations are provided below.

Clean Water Act of 1977 (Federal Water Pollution Control Act of 1972): This Act provides regulation of the discharge of pollutants into the waters of the United States. Permits under Section 401 and 404 are required for implementation of the Proposed Action Alternative.

Endangered Species Act of 1973: The Proposed Action Alternative would have no effect, or would not be likely to adversely affect federally listed endangered and threatened species.

Environmental Justice: Environmental justice must be applied to the greatest extent practicable and permitted by law (in accordance with Executive Order 12898). It assures that all populations are provided with the opportunity to comment on issues before decisions are rendered and allows all people to share in the benefits of, and not be excluded from or affected in a disproportionately high and adverse manner by government programs and activities affecting human health or the environment.¹¹

The Proposed Action Alternative was assessed to determine whether it would disproportionately impact minority or low-income populations. It was determined that the alternative would not have disproportionate adverse health or environmental impacts to minority or low-income populations.

Farmland Protection Policy Act of 1980 and 1995: The Act requires identification of actions that would affect any lands classified as prime and unique farmlands. The Act contains direction to take into consideration the extent to which federal programs or actions contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. The Proposed Action Alternative would not affect prime farmland as identified by the NRCS.

National Historic Preservation Act of 1966: A cultural resource survey was completed for the Proposed Action Alternative to insure compliance with the National Historic Preservation Act of 1966 (as amended). Implementing the Proposed Action Alternative would not affect sites that are listed or eligible for listing in the National Register of Historic Places.

¹¹ <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/?&cid=stelprdb1043791>

6. CONSULTATION AND COORDINATION

The following agencies, tribes, and organizations were consulted during the development of this environmental assessment:

Federal Agencies

Advisory Council on Historic Preservation
U. S. Fish and Wildlife Service

State Agencies

Wyoming Game and Fish Department
Wyoming State Historic Preservation Office

Tribes

Eastern Shoshone Tribe
Northern Arapaho Tribe
Northern Ute Tribe

Local Agencies

Little Snake River Museum

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7. GLOSSARY OF TERMS

Aggradation: An increase in streambed elevation by sediment deposition and a corresponding decrease in channel capacity.

Aquatic: Living or growing in water.

Area of Potential Effect: The area of potential effect (APE), as defined by the boundaries for National Register properties¹², is the area in which eligible properties may be affected by the undertaking, including direct effects (such as destruction of the property) and indirect effects (such as visual, audible, and atmospheric changes which affect the character and setting of the property). The APE may include historic properties that are outside the limits of the undertaking.

Background (relative to watershed): A watershed's natural sediment production and delivery (assuming no disturbance).

Barbs: Rock structures used as a stabilization measure that extend into the stream/river flow to modify flow patterns and bed topography.

Best Management Practices: Structural and/or management practices employed before, during, and after construction to protect water quality. These practices provide techniques to either reduce soil erosion or remove sediment and pollutants from surface runoff.

Boulder Clusters: Groups of boulders placed in a stream to improve habitat and create areas of reduced flow velocity.

Chute Cutoff: This type of cutoff occurs when river cuts through a point bar and decreases sinuosity.

Critical Habitat: Defined in the Endangered Species Act as: (1) the specific areas within the geographical area occupied by the species, at the time it is federally listed, on which are found those physical or biological features essential to the conservation of the species, and which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed, when it is determined that such areas are essential for the conservation of the species.

Cross-vane: Rock structure built below the water level to control the direction of flow within a stream.

Cumulative Effects: Effects resulting from incremental effects of actions, when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions.

Direct Effects: Effects occurring at the same time and place as the initial cause or action.

Effects: Impacts; physical, biological, economic, and social results (or expected results) from implementing an activity.

¹² <http://www.nps.gov/nr/publications/bulletins/boundaries/bound1.htm>

Erosion: General term for movement of soil particles on the surface of the land initiated by rainfall and moving water.

Entrenchment: Vertical containment of a river.

Floodplain: The low, flat, periodically flooded lands adjacent to the river.

Glide: The smooth, fast-moving part of a stream or river that separates pools from riffles.

Head gate: A gate used for controlling the water flowing into a channel or irrigation ditch.

Hydrologic: Involving the movement and properties of liquid water in environmental systems; includes the circulation patterns of water in the biosphere from condensation and precipitation to movement both on and under the ground surface to evaporation back into the atmosphere.

Impacts: Physical, biological, economic, and social results from implementing an action or activity.

Infiltration Gallery: An infiltration gallery is a horizontal drain made from open jointed or perforated pipes which is laid below the water table and collects groundwater. Infiltration galleries are often used in combination with other water supply systems as a means of increasing the quantity of water intake in areas with poor water yield.

Issue: Point of discussion, debate, or dispute about the environmental consequences of the proposed action.

J-hook: Shifts flow currents away from bank and reduces bank erosion

Meander: A bend in a sinuous stream or river.

Monitoring: Collecting information to evaluate if objectives and anticipated results of a management plan are being achieved.

National Agriculture Imagery Program: The National Agriculture Imagery Program (NAIP) acquires aerial imagery during the agricultural growing seasons in the continental U.S. A goal of the NAIP program is to make digital ortho-photography available to governmental agencies and the public within a year of acquisition

Neck Cutoff: A meander cutoff formed where a stream breaks through, or across, a narrow meander neck.

Pool: A segment of river or stream where the water is deeper and slower moving. Pools usually form in the thalweg near the outside bend of meanders between riffles.

Riffle: The riffle is a bed feature with gravel or larger size particles where the water depth is relatively shallow and the slope is steeper than the average slope of the channel. Riffles are typically found entering and exiting meanders (bends).

Riparian: In general, described as being situated on the bank of a river or other body of water. The term is often applied both to species that live near streams and to the area adjacent to streams where vegetation and microclimate are influenced by the presence of the stream.

Riprap: Rock material used to stabilize stream banks.

Rosgen Type C Stream: Type C streams are slightly entrenched, meandering systems characterized by well-developed floodplains. They have a riffle-pool bed form and are typically wider than they are deep.¹³

Run: A smooth flowing segment of a stream or river.

Scoping: The process used to identify the scope of issues to be addressed and to determine the significant issues related to an action or activity.

Sediment: In relation to soil particles in water. Suspended sediment consists of small soil particles carried along by the water's flow.

Slough: Low spot on the floodplain that contains moving water.

Thalweg: The line defining the lowest elevation points along the length of a river bed or valley.

Width-to-Depth Ratio: The width-to-depth ratio is the fraction of mean bankfull depth to bankfull width.

¹³ <http://ohioline.osu.edu/aex-fact/pdf/AEX44501StreamClassification.pdf>

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